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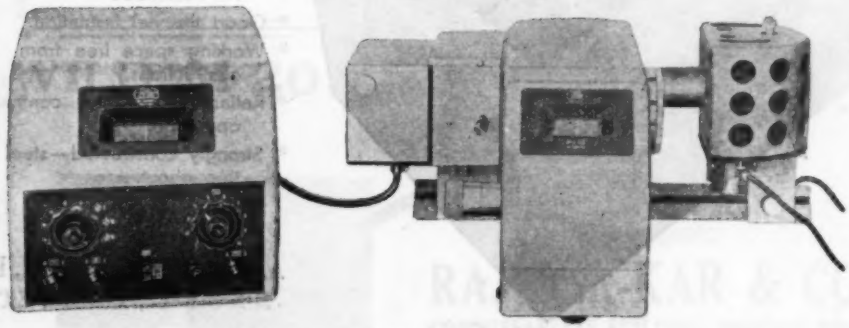

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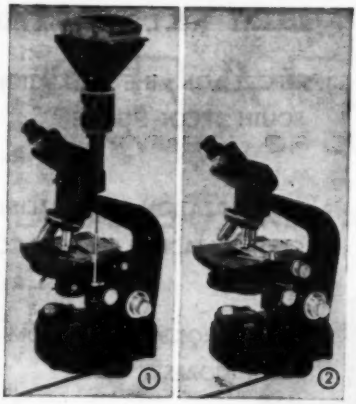

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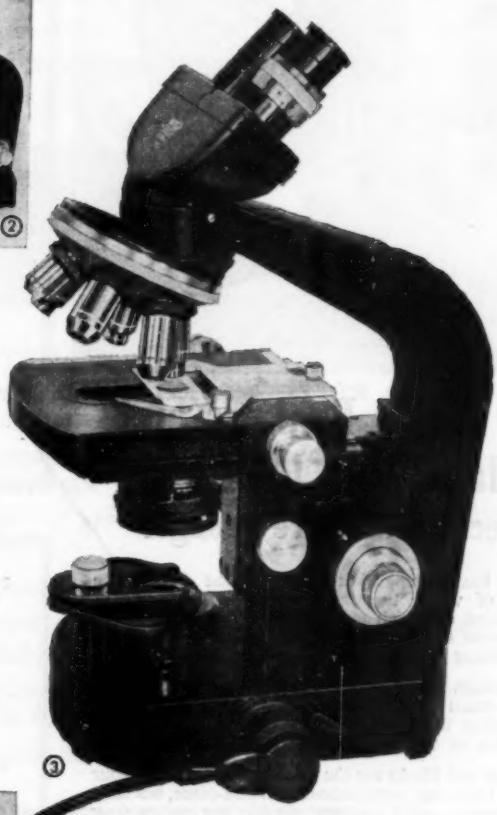

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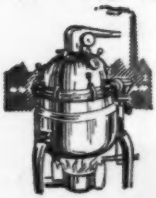

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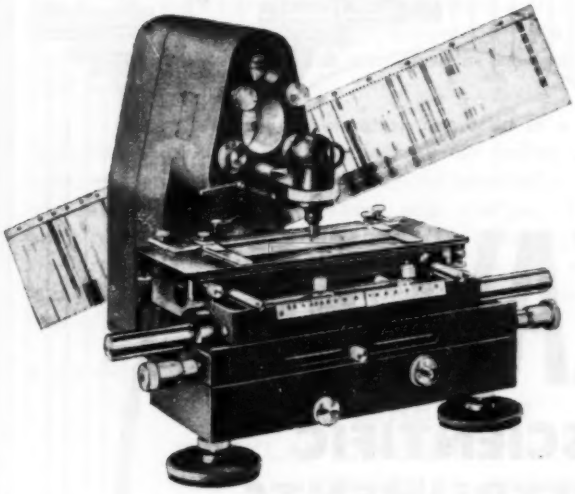

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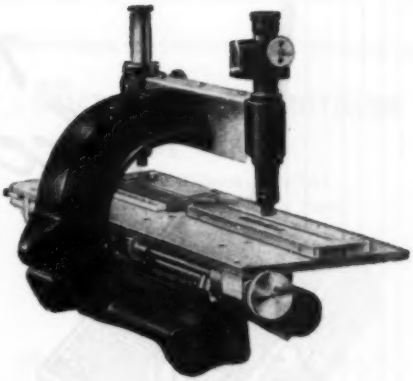

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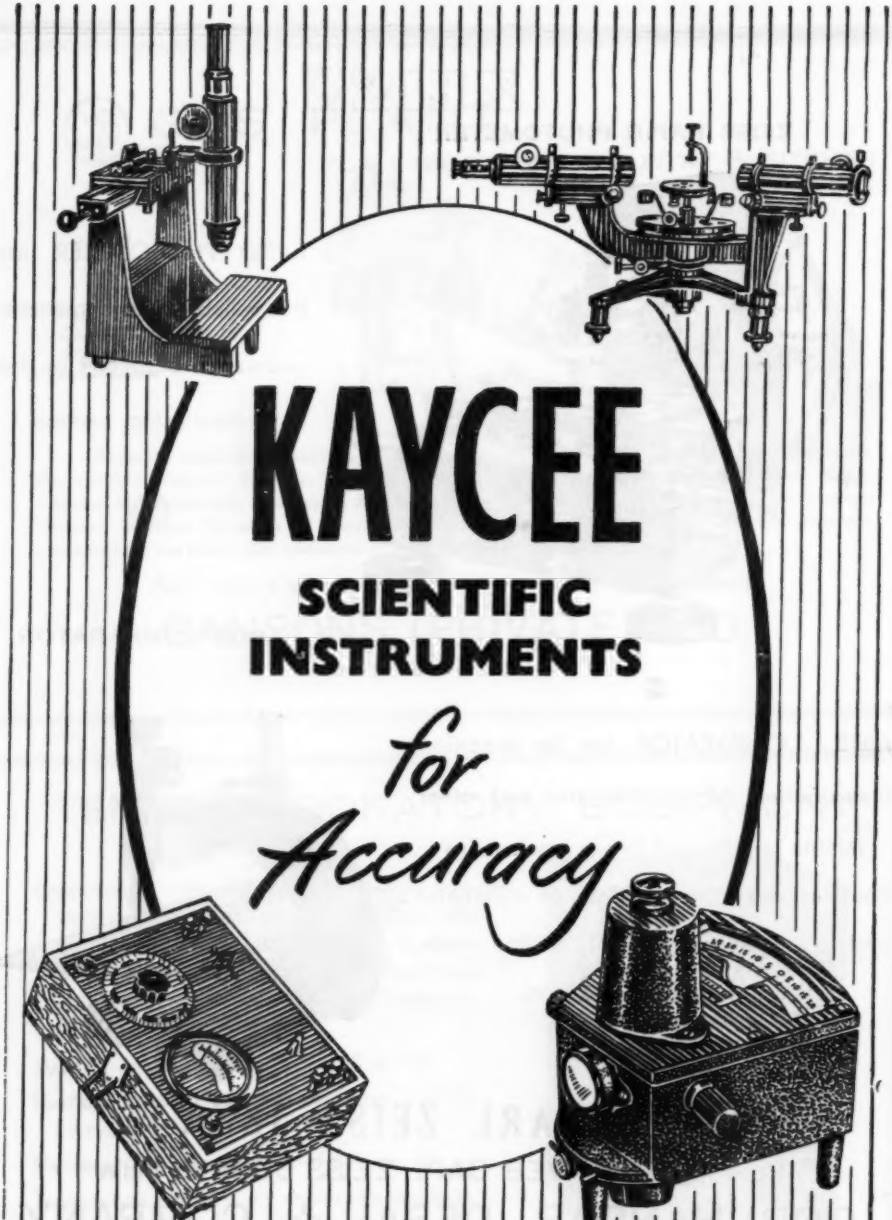

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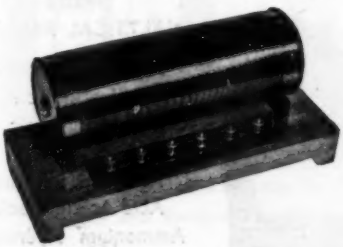

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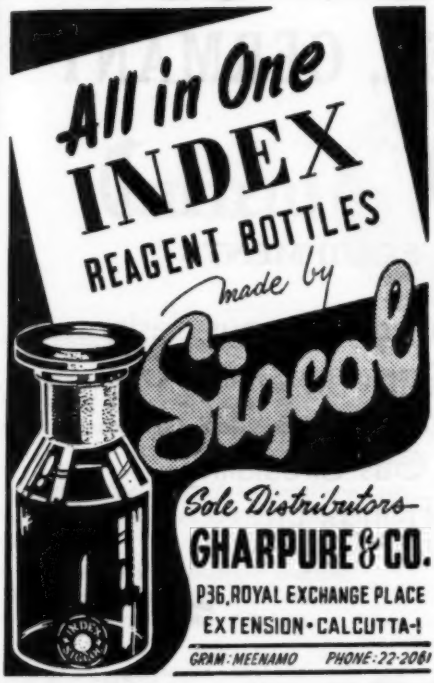

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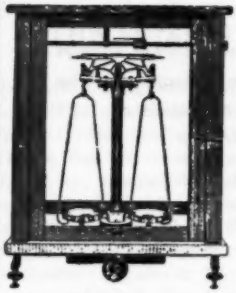

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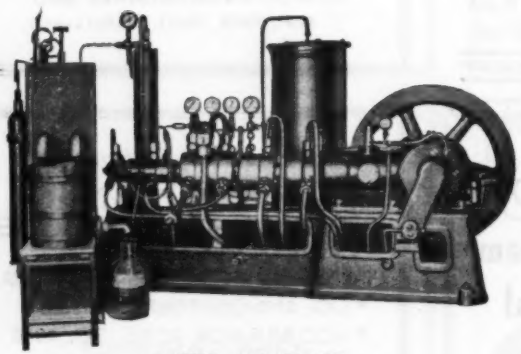

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THE SCIENTIFIC VALUE OF ARTIFICIAL SATELLITES*

THE satellite programme of the U.S.A. forms part of its contribution to the International Geophysical year 1957-58, and the Department of Defence has been assigned the major task of setting up a satellite into an orbit round the earth, as well as proving that they have done so. It is intended to put up into a satellite orbit a hollow sphere weighing 21½ lb. and with diameter of about 20 in. It should also be a good reflector, for a mirror-like surface is desirable on the satellite so that it can be observed optically. The launching will probably be done with three-stage rockets. The first stage, which drops off, will be very large, comprising most of the mass and weighing something like 20,000 lb. It will go up to an altitude of about 40 miles, with a velocity of about 4,000 miles per hour, and then fall off. The second stage will continue on upward to about 130 miles; the last stage will carry the small 21 lb. satellite into an orbit with a velocity of about 18,000 miles per hour. It will revolve once around the earth in some 100 minutes. The plan is to put it into an orbit so that its minimum distance from the earth is 200 miles and the maximum, 800 miles.

Launching will take place from the Patrick Air Force Base at Point Canaveral, Florida, U.S.A., such that the satellite travels in an orbit inclined 28° or more to the earth's equator. Thus, as it goes around the earth it will pass over all latitudes between 28° N. and 28° S. Also it is intended to make six 'earnest' tries, and it is hoped that perhaps half of them will be successful. Then the IGY hopes to send up six more, making a dozen attempts all together; possibly no two of the satellites will be alike.

With a view to ascertain whether the satellite is really up there in the orbit, a small transmitter operated by super batteries will be put inside each satellite. This transmitter will probably operate on 108 megacycles per second

* Based on a lecture by Dr. Fred L. Whipple, Director, Smithsonian Astrophysical Observatory, Cambridge, Mass., summarising the proceedings of the symposium on 'Earth Satellites as Research Vehicles' held at the Franklin Institute, and reported in their *Journal* (1956, **262**, 95). A preliminary report on U.S. Satellite Programme appeared in an earlier issue of *Curr. Sci.* (1956, **25**, 45).

(about 3 metres wavelength). The weak signals, of the order of milliwatts, can be picked up by very large antennas on the ground every time the satellite comes within 600 miles, and even be used to locate it to an accuracy of the order of a minute or two of arc.

Even if the electronic system fails, the satellite can be sighted by its reflected light from ground observing stations under the direction of Smithsonian Astrophysical Observatory. This has to be done with considerable care and at the right time, for the only time when the satellite can be seen in the twilight period when the satellite is more or less overhead and the sun has already set a bit below the horizon so that the sky is not too bright. At such times, a 20 in. sphere at a minimum distance of 200 miles will be just brighter than the 6th magnitude, which is the theoretical limit of the naked eye. This means that it does not take much optical aid; binoculars, for example, will do for a lay observer to observe it, provided he knows where to look and when.

One important aspect of this programme is the organisation of the non-professional astronomers and other interested observers into groups so that they can systematically look for the satellite and help to find out what happenned to it in case the transmitter system fails.† There is another time when amateur observations will be of extreme importance; that is when the satellite is about to come down. About this one cannot be certain to a degree of accuracy better than a factor of 3—possibly not within a factor of 10 even—since we have no exact data at present about the atmosphere at altitudes 200 miles and above. A reasonable estimate is, the satellite will stay up for a good many weeks and will start falling rapidly in about a year.

In any case, as the satellite falls into the atmosphere, the rate at which it comes down, or in other words, the resistance of the atmosphere, is a direct measure of how much air is up there. Simply by tracking the satellite round its orbit, one can determine the density of air at various heights up to approximately 300 miles. If in addition the composition of the air is also known, we could tell the temperature. Both are extremely important data about the very high atmosphere.

The problem of predicting where the satellite will be at any instant requires quite a performance from the computing machines, for predictions are needed about once every minute, and even then hardly sufficient, because in a minute the satellite will have raced over nearly 300 miles.

The satellites are expected to add materially to our scientific knowledge and the equipment inside each satellite will measure some physical quantity, probably two or three. In the earlier ones there may be devices that will measure, for example, the noise when a meteor pings the surface of the satellite. These little dust-like particles are not big enough to make visual shooting stars before they get into the earth's atmosphere, but upon striking the surface of the satellite they will make a noise which can be picked up by a very sensitive microphone. Here, one would like to know how often a sphere like this will be punctured by meteors. The best way to get an answer is to put a little bit of air pressure in the satellite, then add a pressure measuring device, which will then give a record of the pressure in the sealed up sphere. If a little hole is punctured by a meteorite, the pressure will fall off and by measuring the rate of fall one can determine the size of the hole made, and eventually the number of such particles.

One observation which will certainly be made in one of the earliest satellites will be a measurement of cosmic rays. A major question which is not yet clearly resolved is whether some of the weaker cosmic rays come from the sun, or whether their variations with solar activity are caused by changes in the earth's or the sun's magnetic field. If we can get direct cosmic ray measures out in the satellite orbit, well above the dense part of the earth's atmosphere, then a great deal can be learnt about the origin of the cosmic rays and perhaps this will enable us to settle this particular problem. At the same time we can measure the number of hydrogen atoms which are being shot off continuously from the sun and which produce the Aurora Borealis when they strike the upper atmosphere.

Solar activity in the far ultraviolet, in fact over all regions of the spectrum, can also be investigated. For, at present most of the far ultraviolet is being absorbed by the atmosphere, but if we can get above the atmosphere, all this radiation comes pouring into our measuring instruments. Then we can find out how the sun varies when it changes its light in the far ultraviolet and how it produces magnetic storms and the Aurora Borealis.

And then we can determine the shape of the earth provided the orbital path of the satellite can be ascertained to a high degree of accuracy. From this can be deduced quantities con-

† It is understood that an observing station will be set up in this country either at Delhi or Nainital.

cerning the gravity, the density of material, and isostasy, the plastic flow represented by the way continents spring back up after being depressed by ice in the Ice Ages.

There is also the very interesting problem of the radiation of the night sky about which the satellite may be made to tell us much. For, with very simple equipment up there, one can hope to distinguish among four different sources of night sky light: light from the upper atmosphere, light from the solar system, light from the Milky Way and light from the distant galaxies. It may also be possible with rather simple equipment to separate these sources in the far ultraviolet and in the near ultraviolet. Even in the visual region we could possibly determine some answers about cosmology. Are we living in a universe in which everything is blowing up and all the galaxies moving away? Are galaxies short-lived or, as some suggest, would the system always look the same whether we see it now or ten billion years in the past, or ten billion years in the future? We may be able to discriminate among some of those theories simply by measuring the amount of light in the background of the skyline, down to 5% or 10% level of the night sky brightness, the part that comes from the very distant galaxies at incredible distances into space.

Just a word or two about the future beyond this very first step that is being made. The satellites can be divided into classes by weight, starting off by say, a tenth of the one that is planned—a 2 lb. satellite, which is quite useless because one can never prove that it has been launched. When the order of about 10 lb. to 20 lb. is reached, a satellite object can be built which can, at least, be observed and instrumented to some extent. The next step, using more powerful rockets and with mastery of the technique, is to send up something about 10 times as heavy, say, 200 lb. At this stage, perhaps nuclear power supplies can be utilized, so that the power system will last for years, even decades or centuries. Or perhaps solar batteries can be used to transform solar radiation into electrical energy. Probably a transistorized television system can be included to take photographs from such a satellite.

The next step is perhaps the 2,000-lb. satellite, in which all of these things can be done better through the inclusion of a small pysical laboratory. At about this size we come, not to the manned rocket, but something near to the puppet-type rocket. A puppet remotely controlled from the earth by radio techniques, can do any of the useful things up there that man can do. Since the senses are useless in space except for sight and touch the puppet will need only television eyes and a feedback servomechanism to replace man completely.

Extremely valuable results in regard to meteorology and weather conditions can be expected when even the 200-lb. rocket becomes possible. This progress will complete the revolution in meteorology which is now under way in the form of mechanising the collection of data and the calculation of weather forecasts.

It is perhaps no exaggeration to say that the satellite programme is the most marvellous scientific development that has happened in recent years, and the programme derives added interest from the fact that the greatest scientific discoveries resulting from it will hardly be those anticipated.

1956 KALINGA PRIZE AWARD TO PROF. GEORGE GAMOW

PROFESSOR GEORGE GAMOW, of the University of Colorado, has been awarded the 1,000 pounds sterling Kalinga Prize for his work in popularizing science. Previous winners of the prize have been Professor Louis de Broglie, 1952; Dr. Julian Huxley, 1953; Waldemar Kaempffert, 1954; and Dr. August Pi Suner, 1955.

Prof. Gamow is well known for his researches on the theory of radioactive decay, relativistic cosmology and the origin of chemical elements, and the theory of protein synthesis. In particular, he is the discoverer of the celebrated "Tunnel Effect" which explains, on the basis of wave mechanics, how electrically-charged particles can reach the nucleus of an atom.

Prof. Gamow is also famous as an author of books in the field of science popularisation which have been translated into twelve languages and in some cases published in Braille. They include "Theory of the Atomic Nucleus", "Mr. Tompkins in Wonderland", "Mr. Tompkins Explores the Atom", "Mr. Tompkins Learns the Facts of Life", "Birth and Death of the Sun", "1, 2, 3.....Infinity", etc. He is now working on "Matter, Earth and Sky".

A NEW METHOD FOR THE STRUCTURE ANALYSIS OF NON-CENTROSYMMETRIC CRYSTALS

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NO direct methods are available at present for the determination of the phases of structure factors of a single non-centrosymmetric crystal. If two isomorphous crystals are available and if the positions of the replaceable atoms (A) in the unit cell can be fixed, then the phases of the various reflections can be determined but for an ambiguity between two possible values. This ambiguity is in the sign of the phase θ with respect to the phase of the contribution from the replaceable atom, say, $\alpha_A(hkl)$, so that the phase of the structure factor $F(hkl)$ may be either $\alpha_1 = \alpha_A + \theta$ or $\alpha_2 = \alpha_A - \theta$. In all the determinations made so far, the replaceable atoms are related by a centre of inversion so that the phase $\alpha_A(hkl)$ is either 0 or π and so $\alpha_1 = -\alpha_2$. In such a case, if a Fourier synthesis is calculated using both α_1 and α_2, then the resulting diagram will consist of the structure, duplicated by its inverse at the inversion-centre of the replaceable atoms. If the replaceable atoms do not have a centre of symmetry, then no simple relation exists between the Fourier synthesis calculated by using both α_1 and α_2 and the actual structure.

DETERMINATION OF PHASE FROM ANOMALOUS DISPERSION

It is possible to obtain the phases directly, without the need for an isomorphous pair of crystals by making use of effects of anomalous dispersion. Suppose the crystal contains one atom or a set of atoms, for which the imaginary component of the scattering factor is appreciable, while for all the other atoms, this component is negligible. Such a situation occurs in a large number of organic compounds, containing a halogen or sulphur or a metal atom, in addition to C, N and O. In such a case, it is possible to find the phase $\alpha(hkl)$ with reference to the phase $\alpha_A(hkl)$ of the anomalous scatterer.

Fig. 1 represents the various components of the structure amplitudes of a reflection hkl and its inverse $\bar{h}\,\bar{k}\,\bar{l}$. The latter are indicated by a bar over the symbols. F_A' is that part of the contribution from the anomalous scatterer which depends upon normal dispersion and F_A'' is the part which is produced by anomalous dispersion and F_R is the net contribution from all the other non-anomalous scatterers. The relationship between F, $\bar{F}$ and F_A'' is particularly brought out in Fig. 2 where the vectors

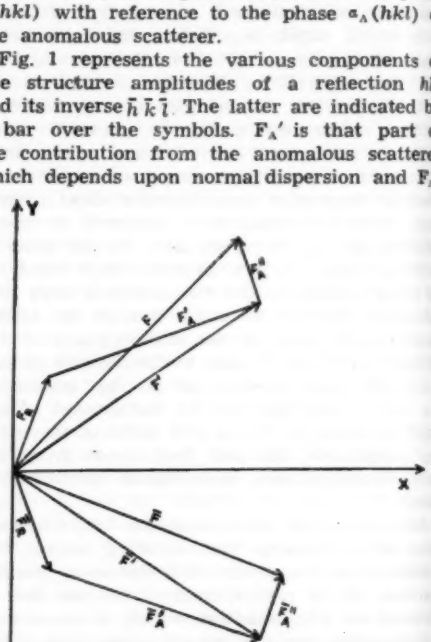

FIG. 1. Diagram showing the relationship between the various components of the structure amplitudes of reflections hkl and $\bar{h}\,\bar{k}\,\bar{l}$.

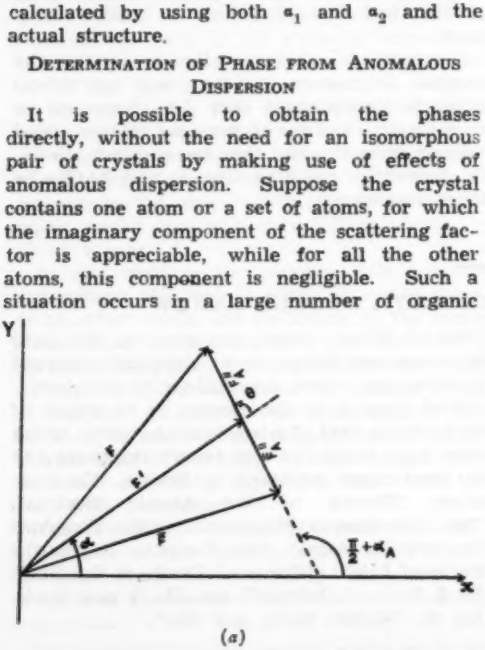

FIG. 2. Relation between F, $\bar{F}$ and F_A''

relating to $\bar{h}\,\bar{k}\,\bar{l}$ have been reflected about the real axis. We have from this diagram, since $\bar{F}_A'' = F_A''$ numerically,

$$F^2 = F'^2 + F_A''^2 + 2\,F'F_A'' \cos\theta$$

$$\bar{F}^2 = F'^2 + F_A''^2 - 2\,F'F_A'' \cos\theta$$

$$F'^2 = \tfrac{1}{2}(F^2 + \bar{F}^2) - F_A''^2$$

Thus

$$\Delta F^2 = (F^2 - \bar{F}^2) = 4\,F'F_A'' \cos\theta$$

and $$\cos\theta = \Delta F^2/4\,F'F_A'' \qquad (1)$$

If $F_A'' \ll F_A'$, an approximate formula is

$$\cos\theta = \Delta F/2F_A''. \qquad (2)$$

Here θ is the angle made by the non-anomalous part of the structure factor with the anomalous part. The phase of F' is obviously $\alpha = \pi/2 + \alpha_A - \theta$, if all the anomalous scatterers are of the same type, *e.g.*, all chlorines. If not, the phase angle ϕ between F_A'' and F_A' can be worked out from the known positions of the anomalous scatterers alone, and then

$$\alpha = \phi + \alpha_A - \theta$$

In the discussion below we shall confine ourselves to the former case when $\phi = \pi/2$ and the extension to the more general case is obvious.

Experimentally therefore, if the difference in intensity of the reflection hkl and its inverse $\bar{h}\,\bar{k}\,\bar{l}$ is measured accurately, then ΔF^2 can be calculated provided the scale factor is known. F_A'' can be calculated from the atomic co-ordinates of the anomalous scatterers (which can be obtained in most cases from a Patterson synthesis) and the known imaginary component of their atomic scattering factors and therefore θ can be obtained.

However, the solution for θ from $\cos\theta$ is ambiguous, since θ can be either $+\theta$ or $-\theta$ and consequently the phase of F' determined in this way has the ambiguity given by

$$\alpha_{1,2} = \pi/2 + \alpha_A \pm \theta$$

This ambiguity is similar to the one occurring in the determination of phase by the isomorphous replacement method. In fact the scattering factor of the atoms A for the two reflections hkl and $\bar{h}\,\bar{k}\,\bar{l}$ are effectively different and this is made use of in the determination of phase.

Ambiguity and Its Resolution

If the group of anomalous scatterers is centrosymmetric, the phase angle α_A is 0 or π and in this case, the two possible values of the phase of F' are $\alpha_1 = \alpha$ and $\alpha_2 = \pi - \alpha$. It can be shown that if a Fourier synthesis is calculated using both the values of the phase, then the resulting diagram would contain, in addition to the peaks of the real structure, an equal number of negative peaks, at positions related to the former by an inversion about the inversion centre of the replaceable atoms. This diagram is similar to what one obtains by performing a Patterson synthesis with ΔF^2 which has been utilised by Pepinsky and collaborators for the determination of absolute configuration.[1] However it is superior to the latter in that only one duplication of the structure occurs and this too in the form of negative peaks, while in the ΔF^2 Patterson, a series of images of the structure as seen from each of the atoms in the set A occurs and the whole series is duplicated in the form of negative peaks about the inversion centre.

Experimental Verification

The method has been tested in the case of ephedrine hydrochloride[2] in which there are two chlorine atoms per unit cell. Only CuKα radiation was used and the anomalous dispersion of chlorine for this wavelength ($\Delta f'' = 0{\cdot}69$) was sufficient to give useful information. The difference in intensity between each pair of inverse reflections was measured accurately with a Geiger counter spectrometer for all the reflections of type $hk0$ and the phases were calculated from expression (2). The measurements were put on an absolute scale by using the reported values of F_c. The values of α as found by experiment are given in Table I together with the values of α calculated from the structure determined by conventional methods. The agreement is seen to be good, the differences rarely exceeding 20°.

Of the two possible values, the one which is nearer to the phase of the chlorine atoms may be chosen for a preliminary synthesis and thus the ambiguity resolved. This assumption is seen to be valid in nearly 75 per cent. of reflections as may be seen from Table I. The phases of those reflections for which the contribution from the chlorine atom is zero are indeterminate and this is a defect of the method. Such reflections are small in number and this difficulty is present even in the isomorphous replacement technique.

Combination of the New Method and Isomorphous Replacement Technique

An interesting possibility arises if a pair of isomorphous substances are available and the replaceable atoms are anomalous scatterers. This is possible for instance with hydrochlorides and hydrobromides

TABLE I

Measurement of anomalous dispersion effect for hk0 reflections of ephedrine hydrochloride. α_1 and α_2 are the two possible values of the phase, and the one which agrees with the phase calculated from the structure is shown in heavy type. The tick mark indicates those reflections for which the correct phase angle is the one which is closer to the phase α_A of the chlorines. The reflections for which the columns beyond the fourth are left vacant are those for which θ is indeterminate, since $F_A'' = 0$.

h k l	$\frac{\Delta\sqrt{I}}{\sqrt{I}}$	$\Delta F = \frac{\Delta\sqrt{I}}{\sqrt{I}} \cdot F_c$	$2F_A''$	θ	α_A	α_1	$\alpha_2 = \pi - \alpha_1$	α from structure	Validity of hypothesis
1 1 0	−0·055	−0·086	−2·02	62	180	**28**	152	61	√
2 1 0	−0·052	−1·487	−2·76	57	180	33	**147**	158	√
3 1 0	−0·012	−0·466	−1·88	76	180	14	**166**	174	√
4 1 0	−0·010	−0·146	0·0	..	..	..	..	..	..
5 1 0	0·103	1·380	2·02	47	0	53	**127**	113	×
6 1 0	0·0	0·0	2·76	90	0	**0**	180	11	√
7 1 0	0·005	0·028	1·88	89	0	**1**	179	4	√
8 1 0	0·0	0·0	0·0	..	..	..	..	..	..
9 1 0	0·064	0·608	−2·02	108	180	342	**198**	225	√
10 1 0	−0·046	−0·409	−2·76	82	180	8	**172**	168	√
11 1 0	0·0	0·0	−1·88	90	180	0	**180**	175	√
12 1 0	−0·016	−0·027	0	..	..	..	..	..	..
0 2 0	0·0	0·0	−2·76	90	180	0	**180**	174	√
1 2 0	−0·025	−0·505	−1·88	74	180	16	**164**	153	√
2 2 0	0·0	0·0	0·0	..	..	..	..	..	..
3 2 0	0·270	1·701	2·02	32	0	58	**122**	116	×
4 2 0	−0·068	−1·292	2·76	118	0	**332**	208	324	√
5 2 0	−0·094	−0·686	1·88	111	0	**339**	209	325	√
6 2 0	0·0	0·0	0·0	..	..	..	..	..	..
7 2 0	−0·067	−0·0549	−2·02	74	180	16	**164**	163	√
8 2 0	0·0	0·0	−2·76	90	180	0	**180**	172	√
9 2 0	0·023	0·276	−1·88	99	180	351	**189**	220	√
10 2 0	−0·038	−0·251	0·0	..	..	..	..	..	..
11 2 0	−0·035	−0·200	2·02	95	0	**355**	195	351	√
12 2 0	0·071	0·511	2·76	79	0	**11**	169	27	√
1 3 0	−0·024	−0·451	2·02	103	0	**347**	193	349	√
2 3 0	0·009	0·156	2·76	87	0	**3**	177	15	√
3 3 0	0·026	0·354	1·88	79	0	**11**	169	10	√
4 3 0	−0·025	−0·315	0·0	..	..	..	..	..	..
5 3 0	0·035	0·371	−2·02	101	180	349	**191**	194	√
6 3 0	0·135	1·053	−2·76	112	180	338	**202**	242	×
7 3 0	−0·060	−0·378	−1·88	78	180	12	**168**	140	√
8 3 0	−0·040	−0·484	0·0	..	..	..	..	..	..
9 3 0	−0·026	−0·086	2·02	92	0	358	**182**	146	×
10 3 0	−0·058	−0·551	2·76	101	0	**349**	191	329	√
11 3 0	0·046	0·179	1·88	85	0	**5**	175	18	√
0 4 0	0·046	0·497	2·76	80	0	**10**	170	22	√
1 4 0	0·007	0·063	1·88	88	0	**2**	178	7	√
2 4 0	−0·012	−0·046	0·0	..	..	..	..	..	..
3 4 0	0·218	0·523	−2·02	105	180	**345**	195	280	×
4 4 0	0·043	0·383	−2·76	98	180	352	**188**	179	√
5 4 0	0·023	0·255	−1·88	98	180	352	**188**	202	√
6 4 0	..	..	0	..	..	..	..	..	..
7 4 0	−0·270	−1·701	2·02	148	0	**302**	238	273	×
8 4 0	0·024	0·250	2·76	85	0	**5**	175	26	√
1 5 0	−0·136	−1·006	−2·02	60	180	30	**150**	124	√
2 5 0	−0·055	−0·798	−2·76	73	180	17	**163**	179	√
3 5 0	−0·122	−0·598	−1·88	71	180	19	**161**	153	√
4 5 0	−0·066	−0·277	0	..	..	..	..	..	..
0 6 0	−0·025	−0·228	−2·76	85	180	5	**175**	161	√

of organic compounds. As already observed, the phase determination by isomorphous replacement is ambiguous. Detailed considerations[3] show that an unambiguous solution for the phases is possible by making use of a double replacement, i.e., when one has two other isomorphous compounds related to the compound under study in which two different groups of atoms are replaced. It is essential that the two groups of replaceable atoms are not centrosymmetric about the same point in the unit cell or about points differing by integral multiples of half the unit translations. Even if these conditions are satisfied, the ambiguity might still occur for some reflections.

The ambiguity in the sign of the phase angle with reference to the phase of the replaceable atoms can however be resolved if the isomorphous replacement method is used in conjunction with the new method. This is so because the latter gives the two values

$$\alpha_1 = \alpha_A + \pi/2 + \theta \text{ and } \alpha_2 = \alpha_A + \pi/2 - \theta$$

while the former gives

$$\alpha_3 = \alpha_A + \phi \quad \text{and} \quad \alpha_4 = \alpha_A - \phi$$

It is seen that one from each set should agree. Thus if $\alpha_1 = \alpha_3$ the other two are always different, and the choice is obvious. The advantage of this combination is that it requires only one pair of isomorphous compounds, and in such cases, an unambiguous solution for the phase is always possible, irrespective of whether the replaceable atoms have a centre of symmetry or not.

The anomalous dispersion method of determining phases is now being used in the analysis of L-lysine hydrochloride in this laboratory.

1. Pepinsky, R. and Okaya, Y., *Proc. Nat. Acad. Sci. U.S.*, 1956, **42**, 286.
2. Phillips, D. C., *Acta Cryst.*, 1954, **7**, 159.
3. Harker, *Ibid.*, 1956, **9**, 1.

SECOND CONGRESS ON THEORETICAL AND APPLIED MECHANICS

THE Second Congress on Theoretical and Applied Mechanics was held under the auspices of the Council of Scientific and Industrial Research on the 15th and 16th October 1956, at the National Physical Laboratory of India under the Presidentship of Dr. K. S. Krishnan, Director of the Laboratory. About eighty delegates were present including some from Germany, Japan, Poland and the U.S.A. Dr. J. C. Ghosh, Member, Planning Commission, who delivered the inaugural address, expressed the hope that the Indian society would soon establish direct contact with the International Union of Theoretical and Applied Mechanics. He also discussed the construction of a suitable model for the separation of diffusion and kinetic processes in gaseous catalytic reactions.

Dr. Krishnan in his presidential address explained the part played by the polarisation field in determining the observed resonance frequencies of the medium with particular reference to alkali-halides where the dispersion of the dielectric constant may also be regarded as exercised indirectly through its influence on resonance frequencies. Dr. P. Nilkantan gave a technical talk on 'The Origin of Ripples on Sand and Allied Phenomenon' where he suggested that the wave pattern was not due to 'saltation' of sand particles, but corresponded to the hydrodynamical effect of a fluid moving over another highly viscous fluid.

The Congress received eighty-six communications from many parts of the world including China, Czechoslovakia, Egypt, Japan, Poland, U.S.S.R. and the U.S.A. Forty-eight of these were presented before the Congress relating broadly to finite deformation, elasticity theory, vibration and stability, fluid flow, heat-transfer, ballistics and statistics.

The Society accepted an invitation to hold the Third Congress in October-November 1957 at the Indian Institute of Science, Bangalore. Dr. S. R. Sen Gupta, Director, Indian Institute of Technology, Kharagpur, was elected President for the sessions 1957-59.

The following other Office-bearers were elected: *Vice-Presidents*: Sri. V. Cadambe and Prof. N. R. Sen; *Secretary-Treasurer*: Prof. B. R. Seth, Indian Institute of Technology, Kharagpur; *Members of the Council*: Sri. C. V. Joga Rao, Dr. G. P. Chatterjee, Prof. B. M. Belgaumkar, Dr. S. K. Roy, Dr. Ram Ballabh, Prof. V. Lakshminarayan, Sri. S. Krishnan, Dr. K. L. Rao and Dr. A. K. Gayen.

OBITUARY

PROF. B. M. DAS (1886-1956)

WE regret to record the death of Prof. B. M. Das, Director, Central Leather Research Institute, Madras, due to heart failure on September 5, 1956.

Rai Bahadur B. M. Das was born in 1886 in Faridpore. He took his M.A. Degree examination in chemistry from the Presidency College, Calcutta University, obtaining the first rank. He carried out research initially on the Chamber Process for the manufacture of sulphuric acid, under Sir P. C. Ray, and was the first to put commercial sulphuric acid manufactured by an Indian firm on the market. Later he proceeded to Leeds University to study leather technology, and obtained the M.Sc. Degree in applied chemistry of leather manufacture. He worked for some time in a big commercial tannery in Milan and for two years served as technical chemist with Farbenfabriken Friedrich Bayer & Co., in Germany.

On his return to India he joined the National Tannery in Calcutta where he worked as its Manager for about twenty-four years, modernising and expanding the tannery. While there, he was instrumental in establishing the Bengal Tanning Institute under the Government of Bengal. In recognition of his services to the leather industry, the Government of India awarded him the title of *Rai Bahadur* and also the Silver Jubilee Medal.

Prof. Das was appointed Chairman of the Leather Panel by the Government of India in 1944, and two years later he went to Germany as Technical Investigator of the German Tanning Industry under the British Intelligence Objectives Sub-Committee (B.I.O.S.). He also visited U.S.A. and U.K. to study the tanning industries in these countries. He was appointed by the Government of West Bengal as its adviser on leather and tanning, and in this capacity, he carried out work at the Bengal Tanning Institute on the adaptation of German processes for the improvement of the Indian leather industry.

The technical reports published by him on these occasions contain valuable information on modern European and American processes of leather manufacture and the manufacture of leather auxiliaries. Besides these reports, he published a large number of bulletins and articles on leather research and leather technology. His book entitled *Handbook of Tanning* published by Government of Bengal as Department of Industries Bulletin No. 63 has had a wide appreciation and has passed through three editions. He has trained a large number of students in leather technology who are at present holding responsible posts in leather industry all over India, Burma and Ceylon.

From 1948 to 1951, he was appointed as Industrial Adviser on Leather and Tanning by the Government of West Bengal, and in September 1951 his services were requisitioned by the Council of Scientific and Industrial Research as Officer on Special Duty, Central Leather Research Institute, Madras. He was appointed as Director of the Central Leather Research Institute in January 1953 in which capacity he rendered valuable service to leather trade and industry till his demise in harness.

Prof. Das was also Hon. Professor of Leather Technology and Chairman of the Faculty of Technology, University of Madras, from 1954 onwards, and was associated with several of the committees connected with leather trade and industry: Leather Research Committee of the Government of India, Hides and Skins Committee of the Indian Council of Agricultural Research and the Leather Section Committee of the Indian Standards Institution.

INTERNATIONAL ATOMIC ENERGY AGENCY

SEVENTY nations last month signed the statute of the International Atomic Energy Agency at the concluding session of a 4-week Conference organized by the United Nations in New York. In his closing speech, Joao Carlos Muniz of Brazil, President of the Conference, emphasized that there was nothing compulsory in the relationship between Member States and the Agency, and that the Agency will not impose complete international control over nuclear fuels or source materials. It would be a free association of nations to bring the benefits of atomic progress to all peoples. The new atomic era, he affirmed, would have much wider consequences than the first industrial revolution. Nuclear materials made available by members of the Agency will be used in agriculture, medicine and for other peaceful purposes.

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INERTIAL FRAMES AND THE FORM OF AN EQUATION OF STATE OF THERMODYNAMIC SYSTEMS

Consider two observers S and S^0 who are in uniform relative motion with respect to each other. If the temperature of a system measured by the two observers are T and T_0, Tolman[1] has shown on the basis of special relativity that

$$T = T^0\beta \qquad (1)$$

where $\beta = \sqrt{1 - \frac{v^2}{c^2}}$, v being the relative velocity of S and S^0 and c the velocity of light. From relativistic mechanics, it is also known that the following relations exist between pressure (P, P_0) and volume (V, V_0) of a system as measured in S and S^0 respectively:

$$P = P^0 \text{ and } V = V^0\beta \qquad (2)$$

If we postulate that the product of pressure and volume of a thermodynamic system is a function of its temperature only, we can write

$$P^0V^0 = F(T^0) \qquad (3)$$

According to the special theory of relativity, all physical phenomena are governed by laws which have the same form in all systems which are in uniform relative motion to each other. Hence we can write a similar equation for the system S also:

$$PV = F(T) \qquad (4)$$

Substituting the relations for P^0, V^0, T^0 in

terms of P, V and T from (1) and (2) in equation (3), we have

$$\frac{PV}{\beta} = F\left(\frac{T}{\beta}\right) \quad (5)$$

or

$$PV = \beta F\left(\frac{T}{\beta}\right) \quad (6)$$

Comparing this with (4) we obtain

$$F(T) = \beta F\left(\frac{T}{\beta}\right) \quad (7)$$

The unique solution of this functional equation is known to be $F(T) = \alpha T$, where α is a constant. Hence we have $PV = \alpha T$, *i.e.*, the product PV must be a *linear* function of the temperature in all systems.

Dept. of Physics, MOHD. SAMIULLAH.
Mahboob College,
Secunderabad, *July* 25, 1956.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, Oxford, 1934, pp. 158–59.

FORCE CONSTANTS OF SOME RADICALS OF XY_6 TYPE

THE Wilson's[1] F-G matrix method of analysis of molecular vibrations has been applied to the evaluation of the force constants of some radicals of XY_6 type, from their Raman frequencies. The radicals discussed here have the octahedral symmetry O_h and give rise to three vibrations active in Raman effect. Of these, one is total symmetric (a_{1g}), one is doubly degenerate (e_g) and the third one is triply degenerate (f_{2g}).

The potential function used in this investigation consists of four force constants f_d, f_α, f_{dd} and $f_{\alpha\alpha}$ which have got the usual significance. The interaction force constant $f_{d\alpha}$ has not been taken into consideration as the secular equations corresponding to the observed three frequencies do not contain $f_{d\alpha}$. The observed Raman frequencies in the case of the radicals discussed here and the force constants obtained from them are given in Table I.

TABLE I

Radical	Observed frequencies cm.$^{-1}$			Force constants (10^5 dyne cm.$^{-1}$)			X – Y in Å Badger's rule[4]
	a_{1g}	e_g	f_{2g}	f_d	f_{dd}	$f_\alpha - 2f_{\alpha\alpha}$	
SiF_6^{2-}	646	466	403	1·902	0·237	0·901	1·61
$SeCl_6^{2-}$	346	273	166	1·294	0·109	0·288	..
$SnCl_6^{2-}$	320	235	158	1·143	0·127	0·261	2·52
$SnBr_6^{2-}$	183	144	69	0·704	0·060	0·112	..
$SbCl_6^{-}$	337	277	172	1·640	0·199	0·310	2·30

Dept. of Physics, K. VENKATESWARLU.
Annamalai University, S. SUNDARAM.
Annamalainagar, *August* 6, 1956.

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ACTION OF TARTARIC ACID ON BRASS

DURING studies on corrosion in brass, a specimen of alpha brass (composition 67·3% Cu, 32·7% Zn) was exposed in a beaker containing 230 ml. of N/1000 tartaric acid solution, and it was found that after three days, a photographic impression of the patent mark on the beaker was formed on the surface of the brass plate (Fig. 1).

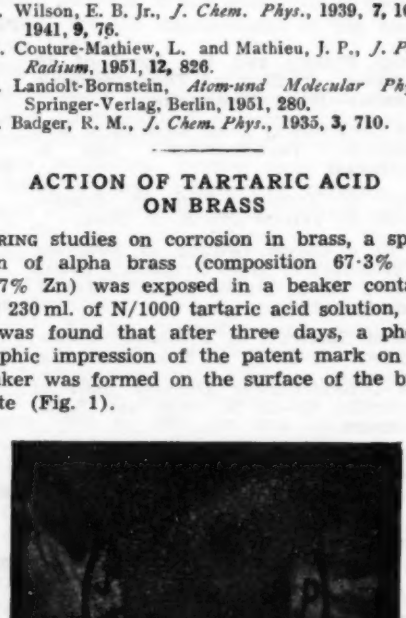

FIG. 1.

Specimens of area 6 cm. × 3 cm. cut accurately were used. Glass hooks were employed for suspension. A specimen piece of the alloy was first washed with distilled-water several times and then dried. It was then polished using successively 0 to 0000 Oakeys' emery papers. A mirror-like finish was obtained by polishing with jeweller's rouge.[1] The specimen was finally degreased by carbon tetrachloride. Tartaric acid of A.R. grade was used and the experiment was carried out at 33° C. After exposure, the specimen was cleaned with distilled-water, dried, weighed and photographed. To find out the loss on corrosion, the exposed plate was subsequently treated in a fresh beaker with 5% sulphuric acid.[2]

Experiments were performed with tartaric acid of various concentrations, from 0·001 N to 1·0 N. Only in 0·001 N was the formation of a photo-sensitive film noticed. In all other cases direct dissolution apparently takes place.

The film shows yellow, brown and bluish green colours. On testing with dilute sulphuric acid the film was blackened; dilute hydrochloric acid removed the film and there was a slight blackening at the sites of the film formation. Dilute ammonia had no effect. When a copper plate was similarly exposed a very faint image was obtained after three days.

Our thanks are due to Ahmedabad Education Society for laboratory facilities and the Gujarat University for the grant of a research scholarship to one of us (M. N. D.).

L. D. Arts College and M. G. Science Institute, Ahmedabad-9, *September* 15, 1956.

A. K. M. Trivedi.
M. N. Desai.

1. Shaw, L. B. and Everdall, M. H., *J.C.S.*, 1942, 599.
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USE OF A COARSE GRATING TO FIND THE WAVELENGTH OF HIGH FREQUENCY SOUND WAVES IN A LIQUID

Diffraction of light by high frequency sound waves traversing a liquid in an optical cell mounted on the table of a spectrometer, is utilised for finding the wavelength of sound waves Δ in the liquid. The angles of diffraction of successive orders differ by θ which is of the order of 12′ or less and an error of 10% is inevitable in the determination of that angle directly by means of a spectrometer, telescope and scale.

Considerable accuracy is obtainable, if a plane transmission coarse grating of accurately known spacing D is also employed in combination with the acoustic grating. Diffraction orders of both gratings are then seen when observed through the telescope of the spectrometer, on which the gratings are mounted, the acoustic grating on an independent platform and the other on the spectrometer table proper. Turning the table, say clockwise, the coarse grating is set at such an oblique angle of incidence i that the apparent spacing of the diffracted orders of the coarse grating becomes equal to that of the other, when exact coincidence between the two sets of different orders take place. Similar coincidence is obtained in another position when the table is turned in the opposite direction. The angle between the two positions is $2i$ which may be made to be of the order of 60° to 90°, when a proper value for D is chosen. The variation δi in the value of i for different measurements is not more than ½°.

In this case the wavelength of sound waves is given by $\Delta = D \cos i$ and the error in its determination is $\Delta = \Delta \tan i \delta i$ which is only about 0·5% when i is 30° and δi is ½°.

The author measured the wavelength of high frequency (7·5 Mc/s.) sound waves in water at 30° using a coarse grating D = 0·05 cm., accurately ruled on silvered glass. The various values of $2i$ when the second diffracted order of the coarse grating coincided with the first diffracted order of the acoustic grating, did not differ by even 1° and the average value was 73° 28′ which yielded a value of $\Delta = \frac{1}{2} D \cos i = 0{\cdot}02004$ cm. for the wavelength of the sound waves in water. The velocity of the waves was found to be 1503 metres per second. Details of this work are being published elsewhere.

Gopala Menon, Sreekantath.

University College,
Travancore University,
Trivandrum, *September* 25, 1956.

INFRARED SPECTRUM OF ORTHO-FLUOROBROMOBENZENE

In continuation of the work on the ultra-violet absorption[1] and Raman effect[2] of ortho-fluorobromobenzene, the infrared spectrum of this compound has been studied. There is no previous report on the infrared spectrum of this molecule.

The spectrum is obtained with a Leitz infrared prism spectrograph equipped with Rock salt and potassium bromide optics. The liquid absorption spectrum in the Rock salt region is reported in the present communication. The spectrum is reproduced in Fig. 1.

About 90 bands are recorded and almost all of them are interpreted in terms of the fundamental frequencies shown in Table I. These fundamentals agree well with the Raman frequencies reported earlier.[2] The fundamentals marked with asterisks occur more frequently in the combination bands. The classification of the vibrations into planar a' vibrations and non-planar a'' vibrations is partly aided by the state of polarisation of the corresponding Raman lines and the relative intensities in the infrared and Raman effect and by the magnitude of

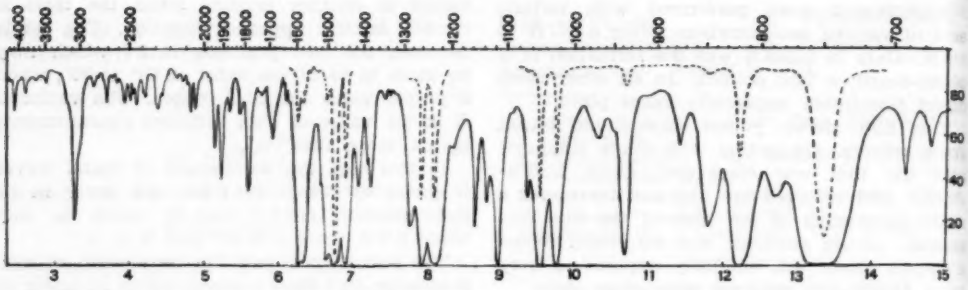

FIG. 1. Infrared spectrum of liquid ortho-fluorobromobenzene. (Solid curve—film thickness ·09 mm.; dotted curve—capillary film.)

the frequencies compared to those of the ortho-fluorochlorobenzene (Nielsen).[3]

The author is grateful to Dr. G. C. Finger of the Illinois State Geological Survey for the gift of the sample. The author is deeply indebted to Prof. K. R. Rao for valuable guidance.

TABLE I

ν	Int.	Species	ν	Int.	Species
694	mw	a″	*1235	s	a′
*750	vvs	a″	1263	s	a′
790	m	a″	1287	ms	a′
*820	vs	a′	*1448	s	a′
*849	ms	a″	*1480	vs	a′
*939	s	a″	*1580	ms	a′
*1026	vs	a′	1592	s	a′
1050	vs	a′	3012	m	a′
*1117	s	a′	3054	ms	a′
*1158	ms	a′	3158	w	a′

S. L. N. G. KRISHNAMACHARI.
Physics Department,
Andhra University,
Waltair, *October* 5, 1956.

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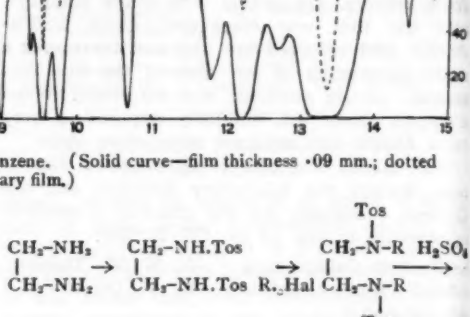
N:N′-DIALKYLETHYLENE DIAMINE SALTS OF PENICILLIN G

A SYSTEMATIC work has been undertaken to discover repository salts of penicillin which could give blood concentrations of the order of about 0·5 units per ml. for about a week after single injection.[1] In the course of this work a series of N : N′-dialkylethylene diamines (IV) and their dipenicillin salts (V) have been prepared as follows:



No.	R	N-N′-Di-*p*-toluene sulphonyl derivative M.P. (III)	N-N′-Dialkyl E.D. Dihydrochloride M.P. (IV)	Dipenicillin G Salt M.P. (V)
1	Methyl	163–64°	232–34°	132°
2	Ethyl	168	260	104–06
3	N-propyl	120–21	295	92
4	N-butyl	119	295–300	111–12
5	N-amyl	116–17	305–10	102–04
6	*Iso*-amyl	119–21	293	108
7	N-hexyl	115–16	284–86	89
8	N-heptyl	112	292–93	98
9	N-octyl	82–83	275–78	93
10	N-lauryl	65–66	252–55	76–78

The condensation of ethylene diamine (I) with the alkyl halides gave a mixture of various substituted products. So the diamines (IV) were prepared *via* the toluene sulphonyl derivative (II)[2] which was alkylated with alkyl halide (R hal.) in presence of potassium hydroxide (10%) in ethylene glycol-alcohol mixture at 140° C., the condensed product (III) hydrolysed with sulphuric acid (conc.) and the amines (IV) isolated as the hydrochloride.[3] In the case of compounds

Nos. 4 to 7, the penicillin salts were prepared by treating the aqueous solution of hydrochloride with aqueous solution of potassium penicillin G and in the case of compounds Nos. 1 to 3 and 8 to 10 by treating the penicillin acid in dry ether with the amine in the same solvent. The yields in all the above steps are quantitative.

The study of their properties like solubility, stability, blood levels and toxicity, etc., is under progress and the details will be published in due course.

Our thanks are due to Dr. K. Ganapathi and Dr. R. Kaushal for the keen interest in the work.

Antibiotics Res. Centre, Hindustan Antibiotics (Private), Ltd., Pimpri, Bombay State, *October* 11, 1956.

G. N. Vyas.
S. G. Dhopate.

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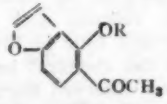
SOME REACTIONS OF PONGAMOL

Hydrolysis of pongamol with absolute alcoholic potash has yielded 5-acetyl-4-hydroxy-benzofuran, m.p. 86° C. (purification by vaccum sublimation) besides 5-acetyl-4-methoxy-benzofuran already isolated[1] by Narayanaswamy *et al.*

Demethylation of 5-acetyl-4-methoxy-benzofuran (I), using hydriodic acid in acetic anhydride solution gave only poor yields of 5-acetyl-4-hydroxy-benzofuran (II), identical with the sample isolated during the alcoholic potash fision. (Found: C, 68·17; H, 4·56; $C_{10}H_8O_3$ requires C, 68·16 and H, 4·54%.)

The structure of 5-acetyl-4-hydroxy-benzofuran (II) has been established by an independent synthesis. O-acetyl karanjic acid[2] was first converted into the acid chloride using thionyl chloride and then condensed wtih excess diazomethane to give the diazoketone which was subsequently reduced using hydriodic acid in chloroform solution as described earlier,[3] followed by hydrolysis to give 5-acetyl-4-hydroxy-benzofuran (II) in good yield.



(I, R = CH_3)
(II, R = H)

5-Acetyl-4-methoxy-benzofuran was similarly obtained starting from O-methyl-karanjic acid.

Dept. of Chemistry, Andhra University, Waltair, *July* 14, 1956.

Ch. Bheemasankara Rao.
V. Venkateswarlu.

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RAUVOLFIA ALKALOIDS IN AVIAN MALARIA (*P. GALLINACEUM*)

Besides their well established therapeutic uses in hyperpiesia and psychiatric conditions, the Rauvolfia alkaloids are considered to be of value by practitioners of indigenous medicine, in clinical disorders like diarrhœa, dysenteries and fevers associated with rigor. A partial explanation for their empirical use lies in the antibacterial activity exhibited by the crude total alkaloids (C.T.A.) on *Micrococcus pyogenes* and *Shigella sonne*. Since many of the fevers associated with rigors are malarial in origin, the effect of these alkaloids on experimental malaria has been investigated.

The effects of crude total alkaloids obtained by methods previously described[1] and of reserpine were both studied.

P. gallinaceum infections in chicken have been reported to be sensitive to all drugs so far discovered to be active in human malaria[2] and hence the screening of these alkaloids has been carried out on this species.

The evaluation, as carried out by standard technique[3] has shown that the oral administration of crude total alkaloids and reserpine in doses of 200 mg./100 g. and 20 mg./100 g. body weight respectively, did not exhibit any suppressive activity or lessening of the severity of the infection, thus indicating the clinical inefficacy of these alkaloids in avian malaria.

Pharmacology Lab., Indian Institute of Science, Bangalore-3, *August* 10, 1956.

R. Rama Rao.
M. Sirsi.

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HALF-WAVE POTENTIALS AND ATOMIC CHARACTERISTICS

THERE have been attempts to correlate polarographic behaviour of inorganic depolarisers with the electronic structure.[1] In this connection, the following relationship which reproduces faithfully half-wave potentials of metals will be of interest. The half-wave potential for most metal ions in cathodic reduction to the metal in 0·1 N KCl is given by the empirical equation

$$E^{\frac{1}{2}} = -2{\cdot}37 + 8{\cdot}828 \times 10^{-26} \times Z/XR^2$$

where E is volts *vs.* S.C.E., Z stands for the atomic number and R is the single bond covalent radius of Pauling. X is a factor which varies from one periodic subgroup to another and assumes for the different subgroups, the values shown in Table I.

TABLE I

Elements	Periodic group	Value of X
Li to Cs	I A	1·0
Zn to Hg	II B	1·0
Al to Tl	III B	1·0
Ge to Pb	IV B	1·0
Bi	V B	1·0
Be to Ba	II A	1·4
Fe to Ni	VIII	1·4
Y to La	III A	3·0
Ti to Th	IV A	2·0
V to Ta	V A	2·0
Cr to W	VI A	2·0
Mn to Re	VII A	2·0
Cu to Ag	1 B	0·7
H	..	0·7
Rare-Earths excluding La		4·0
Uranium Special case		5·5

The half-wave potential values recorded in literature do not all refer to standard conditions. Potentials given with respect to the N.C.E. are easily converted to the S.C.E. scale. In some cases measurements were made and recorded in various electrolytes of differing concentrations. The effect of these on the potential values is not very significant.

A comparison of the observed and calculated values for 49 elements including hydrogen and the rare-earths showed an agreement within ± 0·1 V. Sc however shows a wide deviation amounting to 0·5 V nearly (calculated—2·16 and observed—1·69).

A few typical cases are shown in Table II. The values marked with an asterisk have been taken from the literature.[2] The rest were determined in this laboratory.

TABLE II

Element	$E^{\frac{1}{2}}$ volts *vs.* S.C.E. Cal.	Obs.
Mn^{2+} - Mn°	−1·52	−1·51*
Al^{3+} - Al°	−1·78	−1·75*
In^{+} - In°	−1·08	−1·10
Pb^{2+} - Pb°	−0·38	−0·44*
Ni^{2+} - Ni°	−1·14	−1·10*
K^{+} - K°	−2·17	−2·14*
Ca^{2} - Ca°	−2·13	−2·22*
Sn^{2+} - Sn°	−0·76	−0·83*
U^{6+} - U°	−1·86	−1·90
$(La\ to\ Lu)^{3+}$ - (La to Lu)°	−1·95 to −2·15	−1·94 to −2·14

* Ref. 2.

D. V. N. SARMA.
Andhra University, BH. S. V. RAGHAVA RAO.
Waltair, *August* 4, 1956.

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2. Meites, L., *Polarographic Techniques*, 1955 (Interscience Pub.), Appendix B.

RARE-EARTHS : POLAROGRAPHIC BEHAVIOUR AND ELECTRONIC CONFIGURATIONS

IN a recent communication from this laboratory[1] it has been shown that the reduction of some trivalent rare-earth ions at the dropping mercury electrode in LiCl as supporter occurs in two stages, first to the divalent state and then to the metal. It appears that this reduction in two stages is a characteristic of the rare-earth elements. In some cases, i.e., in elements beyond holmium, by suitably varying the conditions of reduction, three distinct waves have been observed corresponding to the three stage reduction.

$$M^{3+} \rightarrow M^{2+} \rightarrow M^{1+} \rightarrow M^{0}$$

The first reduction, *i.e.*, $M^{3+} \rightarrow M^{2+}$ occurs between −1·79 to −1·91 vs S.C.E. in all elements Y — Lu except Eu and Yb (Pm could not be investigated). In the latter two cases these potentials lie at −0·76 and −1·4 V respectively. This difference in behaviour is of significance in view of the pronounced stability of their divalent state. However, samarium which is also known to be equally stable in its divalent state, reduces only at a higher negative potential and falls in line with other rare-earths. Thus the chemical behaviour does not account for the observed anomaly.

A likely origin may be in the electronic structures of these two elements. The trivalent

rare-earth ions represent the completed xenon core and 0-14 electrons in 4f levels. The divalent state or the M^{2+} ion is reached when an electron is added to this core. Where this addition takes place, is of significance in polarographic studies. Accepted structures[2] for the metal atoms of the rare-earths associate one 5d and two 6s electrons with the elements La, Gd and Lu; in all other cases the 5d orbit is vacant and the extra electrons load the 4f orbit. It follows that in La, Gd and Lu, the M^{2+} ion is formed by the addition of an electron in the 5d level; while in others this electron should enter the 4f level alone. If it were so, the first reduction potentials of the rare-earth ions should fall into two groups—La, Gd and Lu along with Sc and Y falling into one group and the rest into the second. Experimental values point differently; the reduction of $Ce^{4+} \rightarrow Ce^{3+}$ at 0·0 v and $Ce^{3+} \rightarrow Ce^{2+}$ at $-1{\cdot}91$ V is also of particular interest. On the other hand, when it is assumed that the 5d electron is present in all the elements excepting Eu and Yb in which the d electron passes into the 4f level to assume the more stable configuration of 7 and 14 respectively, the observed anomalies in the polarographic reduction potentials stand readily explained.

Andhra University, Waltair, *August* 3, 1956.

D. V. N. Sarma.
Bh. S. V. Raghava Rao.

1. Purushottam, A. and Raghava Rao, Bh. S. V., *Anal. Chim. Acta*, 1955, **12**, 589.
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ISOLATION OF THREE CTYSTALLINE SUBSTANCES FROM THE SEEDS OF *CASSIA TORA* LINN.

The seeds of *Cassia tora* Linn. (Fam. Leguminosæ) are reputed to be a valuable remedy in skin diseases. From them Jois and Manjunath[1] obtained an oil and a small quantity of colouring matter. We have now succeeded in isolating three crystalline substances all of which seem to belong to the group of xanthones. They are provisionally designated as Tora substances A, B and C corresponding to the sequence in which they were isolated.

Tora substance A: orange red rods and needles, m.p. 243-45°; sparingly soluble in sodium hydroxide but soluble in conc. ammonium hydroxide giving yellow solution; with conc. sulphuric acid greenish yellow solution, the rim slowly turning orange. Colour with alcoholic ferric chloride, greenish brown. Probable formula $C_{15}H_{12}O_5$, containing one methoxyl group in the molecule. Diacetate, $C_{19}H_{16}O_7$, m.p. 227-29°; dimethyl ether, $C_{17}H_{16}O_5$, m.p. 184-85°. Tora substance A seems to be a monomethyl-monomethoxy-dihydroxyxanthone.

Tora substance B: yellow needles, m.p. 286-88° (decomp. at 292-94°); yellow solution in sodium hydroxide and sodium carbonate; light pink solution with conc. sulphuric acid and green brown colour with alcoholic ferric chloride. Probable formula $C_{14}H_{10}O_5$ without any methoxyl. Diacetate, $C_{18}H_{14}O_7$, m.p. 206-09°; triacetate, $C_{20}H_{16}O_8$, m.p. 216-18°; dimethyl ether, $C_{16}H_{14}O_5$, m.p. 207-09°; trimethyl ether, $C_{17}H_{16}O_5$, m.p. 186-89°. Tora substance B corresponds to a monomethyl-trihydroxyxanthone and is probably identical with norrubrofusarin, the demethylation product of rubrofusarin which was first isolated from the fungus *Fusarium culmorum* by Ashley, Hobbs and Raistrick.[2]

Tora substance C: red shining needles, m.p. 208-09°, sparingly soluble in all organic solvents and in sodium hydroxide; with conc. ammonium hydroxide a deep yellow solution slowly turning to orange; with conc. sulphuric acid a greenish yellow solution, the rim slowly turning orange; with alcoholic ferric chloride a greenish brown colour. Probable formula $C_{15}H_{12}O_5$ with one methoxyl group. Diacetate, $C_{19}H_{16}O_7$, m.p. 267-69°; dimethyl ether, $C_{17}H_{16}O_5$, m.p. 183-85°; monomethyl ether, $C_{16}H_{14}O_5$, m.p. 207-09°. The dimethyl ether did not depress the m.p. of the trimethyl ether of Tora substance B and the monomethyl ether did not depress the m.p. of the dimethyl ether of Tora substance B. The product of demethylation of Tora substance C did not depress the m.p. of Tora substance B. Tora substance C appears to be a monomethyl-monomethoxy-dihydroxy-xanthone and is probably identical with rubrofusarin.[2] Full details will be published elsewhere.

We thank Prof. C. S. Shah, L. M. College of Pharmacy, Ahmedabad, for the supply of authentic crude drug.

Dept. of Pharmacy, Andhra University, Waltair, *May* 17, 1956.

C. S. Narayana.
S. Rangaswami.

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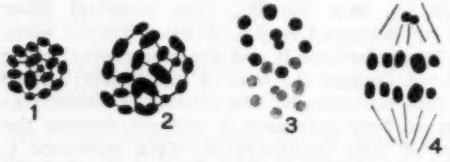
SEX MECHANISM IN *DYSDERCUS* (PYRRHOCORIDAE—HETEROPTERA)

WHILE describing a new type of sex mechanism in *Dysdercus kœnigii*, Ray-Chaudhuri and Manna[1] state that the sex chromosomes, X and Y, though split with typical heteropteran orientation at metaphase 1, segregate as such during both the meiotic divisions. Consequently such a 'double reduction' results, on an average, in the production of three types of spermatids: 50% without any sex element, 25% with the split X and the rest with the split Y. Recently, however, Battaglia[2] has observed that the male sex mechanism in this species is X_1X_2O and not XY. He further states that the two sex elements divide equationally during anaphase I, but the close and non-homologous association of the sex univalents at an early period of anaphase I, just as in *Dysdercus mendesi*,[3,4] has probably led Ray-Chaudhuri and Manna to regard this mechanism as a new type.

Recently a study of the male and female chromosome complements during mitosis and meiosis in another congeneric species—*Dysdercus cingulatus* has been completed in this laboratory. This species differs from *Dysdercus kœnigii*[1] and *Dysdercus* sp.,[5] in having a heteromorphic pair of the sex chromosomes which retain their individuality from the diakinesis onwards, thus allowing their exact analysis most accurately. The spermatogonial metaphase (Fig. 1) reveals 16 chromosomes which can be



FIGS. 1–4. 1. Spermatogonial metaphase (polar view); 2. Oogonial metapase (polar view); 3. Anaphase I (subpolar view); 4. Anaphase II (side view), only five autosomes shown. × 1,500.

classified as one pair of large, a single small and thirteen medium-sized elements. That the small element is one of the sex chromosomes and the second is indistinguishable from amongst the medium-sized elements, is also evident by the size relation of the autosomes and the sex chromosomes in the corresponding oogonial plate (Fig. 2) which shows 18 elements in its polar view. Similarly the size relation of the sex chromosomes, which are undoubtedly X_1 and X_2, at the anaphases of both the meiotic divisions (Figs. 3 and 4) in the male clearly reveals their typical heteropteran behaviour, thus, confirming the conclusions already arrived at by Battaglia,[2] Mendes[3] and Piza[4] that the sex mechanism in the genus *Dysdercus* is X_1X_20 and $X_1X_1X_2X_2$ in the male and female respectively.

A detailed account of these findings on *Dysdercus cingulatus* will be published elsewhere.

Zoological Laboratory, G. P. SHARMA.
Panjab University,
Hoshiarpur, *August* 25, 1956.

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2. Battaglia, E., *Caryologia*, 1956, **8**, 205.
*3. Mendes-Luiz, O. T., *Bragantia*, 1947, **7**, 243.
*4. Piza, S. de Toledo, *Ibid.*, 1947, **7**, 269.
5. Manna, G. K., *Proc. Zool. Soc.*, Bengal, 1951, **4**, 1.

* Not read in original.

MACRONUCLEAR REORGANISATION IN *DIOPHRYS APPENDICULATA* (*CILIATA HYPOTRICHA*)

PRIOR to fission, in *Euplotes patella*,[1] *Aspidisca lynceus*, *Diophrys appendiculata*, *Stylonychia pustulata*,[2] and in *Urostyla grandis*,[3] a peculiar non-staining space, the "reorganisation band" appears in the macronucleus. The reorganisation band traverses the entire length of the macronucleus, leaving the chromatin reticulum in a greatly altered condition.

The process of migration of the reorganisation bands is different in the various species of hypotrichs. In *Euplotes patella*, a pair of bands, one at each tip of the macronucleus, appear and migrate through the substance of the macronucleus, finally disappearing in the middle. In *Aspidisca lynceus*, the band appears in the centre of the "C"-shaped macronucleus, separating a small mass of chromatin. As this grows larger, the band divides into two and move to the opposite sides finally disappearing at the tips of the macronucleus. In other hypotrichs where there is more than one macronucleus, a single reorganisation band appears in each. The passage of the bands has been ascribed to a process of reorganisation.

However, Summers observed in the dumbbell-shaped macronucleus of the daughter individual of *Stylonychia pustulata* a pair of reorganisation bands. He believes that this may be due to the high fission rate of the culture, when the reorganisation bands of the next fission appear precociously.

It is a matter of considerable interest that in one of the numerous specimens of *Diophrys appendiculata* (Fig. 1) examined a pair of well

FIG. 1

Photomicrograph : *Diophrys appendiculata* macronucleus showing the double bands. (Feulgen's stain.)

defined reorganisation bands in one of the macronuclei was observed. The presence of two reorganisation bands instead of one recalls the type of reorganisation in *Aspidisca*. The chromatin bounded by the two bands in the present case was more densely stained with Feulgen's stain, while the terminal tips were lightly stained, a condition which is similar to that in *Aspidisca* at a later stage of reorganisation. Titler has also observed the double bands in some bits of the macronuclei in *Urostyla grandis*, but the author has not offered any explanation for the presence of the double bands. Further work on the reorganisation of macronucleus in different hypotrichs is in progress.

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A NEW SHIPWORM FROM TONDI, SOUTH INDIA

WHILE making a survey of *Teredinidæ* in South Indian waters, 18 species of shipworms belonging to the genera *Teredo* and *Bankia* were collected, identified and described.[1-3] Of these, 12 were found to be new to science. Roonwal[4] recorded the occurrence of the genus *Bactronophorus* from the Sundarbans. The present note deals with one more new shipworm *Teredo* (*Psiloteredo*) *tondiensis* of which four entire specimens and several shells and pallets were collected from the wooden piles (*Borassus flabellifer*) used for the turtle cages in the port of Tondi on the East Coast (Lat. 9° 44' N.; Long. 79° 2' E.).

Measurements.—One specimen 6·2 cm. long has been selected as the type for description. Shell length—5·1 mm.; Shell height—5·7 mm.; Diameter of shell—6 mm.; Pallet length—5·6 mm.; Pallet stalk alone—1·3 mm.; Diameter of blade—2·1 mm.

FIG. 1. Entire Animal.

Characters.—Shell globular and white. Its extreme anterior portion with a sinus and reflected callus which extends over the anterior external margin of the anterior lobe. From the edge of the sinus about 32 denticulate ridges bent downward and then evenly curve backward towards the anterior median area. They

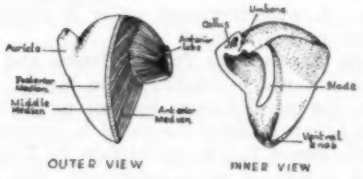

FIG. 2. Shell.

are separated at their posterior termination by spaces slightly wider than the dental ridges. These ridges are finely serrated at their free margin. The anterior lobe is a comparatively broad area which is more than twice the anterior median and equivalent to posterior median and auricle combined. The anterior median portion is a narrow region crossed by about 36 denticulated ridges provided with rows of finely denticulated tubercles and separated by lines of growth. These ridges join those of the anterior area at almost a right angle. The middle median is concave and crossed by coarse low U-shaped non-denticulated extensions of the ridges of the anterior area. The posterior median is slightly wider than either the middle median or the auricle and its surface is smooth. The auricle is only moderately prominent, almost as broad as the anterior median. It is not sharply differentiated from the posterior median portion. Interior pearly white. The auricle joins the posterior median without any differentiation.

The auricle does not in any way project over the posterior median as a shelf. The blade is broad, straight and approximately half the length of the shell. The umbonal knob is strong.

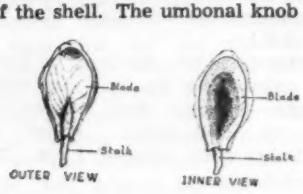

FIG. 3. Pallet

The pallet is spoon-shaped with a short, straight, flexible stalk, which is only slightly more than a fourth of the length of the entire pallet. The blade is roughly oval, the extreme distal portion on the outer surface is marked by a few concentric lines. The inner side is smooth and concave from side to side. The whole pallet blade is covered over by a thick almost transparent periostracum. The inhalent siphon is broader than the exhalent and is fringed at the entrance. In preserved specimens, the siphons are in a state of contraction. Both inhalent and exhalent are conjoint until near the extremities and are almost of equal lengths. A well-developed collar is present at the base of the siphons.

Of the three genera *Teredo*, *Bankia* and *Bactronophorus* which constitute the family Teredinidæ, the present form belongs to the genus *Teredo* Linnaeus since the pallet is spoon-shaped. This genus *Teredo* established by Linnaeus in 1758 includes a dozen subgenera. The forms before us come under the subgenus *Psiloteredo*, by virtue of the following features: 'The auricle fuses with the posterior median portion on the inside in such a manner that no shelf projects. The pallets are spoon-shaped with the outer distal portion slightly excavated.' This subgenus established in 1922, on the basis of the form *Teredo dilatata* Stimpson, by Bartsch[5] now includes about seven species.[6,7] A comparative study of the description of these suggests that the present form does not belong to any one of them. However, it resembles *Teredo* (*Psiloteredo*) *jamaicensis* Bartsch and *Teredo* (*Psiloteredo*) *sigerfoosi* Bartsch in the general features and relative proportions of the shells and pallets but differ from the first in having a narrow anterior median portion and in having only 32 dental ridges for the anterior lobe. Further the forms before us have a wider posterior median than the anterior median. Again the pallet is described as irregular in shape with a twisted and curved stalk very unlike the present form. *T* (*P*) *sigerfoosi* differ from the present form not only in the number of ridges on the anterior lobe but also in having a broadly ovate, solid and smooth pallet, whose stalk is irregular and twisted. Hence the present form is described as a new species, *Teredo* (*Psiloteredo*) *tondiensis* and can be defined as follows:

Teredo with a distinctly spoon-shaped pallet, with a roughly ovate blade covered by a translucent periostracum and marked by a few concentric lines on the distal aspect of the outer surface, with a flexible stalk which is only slightly more than a fourth of the entire pallet length and with a shell, whose length is less than its height, with a moderately large auricle and an anterior lobe bearing about 32 dental ridges when the shell length is 5·1 mm. and shell height 5·7 mm.

The type will be deposited in the Zoological Survey of India, Calcutta, and the paratypes will be in the Zoology Museum of Alagappa College, Karaikudi.

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OCCURRENCE OF INTRA-NUCLEAR NEUROSECRETORY MATTER IN THE TADPOLES OF *RANA HEXADACTYLA* LESSON

AMPHIBIAN neurosecretory cells and their relationship to the hypophyseal system have been investigated by various authors.[1] Studies on species of *Bufo* and *Rana pipiens* have demonstrated that cytoplasmic components, stainable blue by Gomori's chrome alum-hæmatoxylin, are transported along the axons of the neurosecretory cells to the neurohypophysis. In addition Hild[2] and Imai[3] have also drawn attention to the liberation of stainable secretory colloids into the extracellular space to be ultimately released into the diencephalic ventricle. In examining the neurosecretory system of the common frog *Rana hexadactyla* Lesson, it was observed that in the tadpole,

stainable granules and tiny droplets are produced inside the nucleus of the neurosecretory cells of the pre-optic region.

In tadpoles aged about 45 days the pre-optic nucleus is well defined and each neurosecretory cell of this region measures 7 μ to 8·4 μ in length, with a nucleus of about 5·6 μ in diameter. Granular colloids fill the cytoplasm of these cells and axons measuring up to 14 μ in length have been followed up from these cells. In the nuclei of these cells granular bodies stainable bright blue in Gomori's chrome alum-hæmatoxylin, measuring about 0·7 μ in diameter have been observed. Often similar granules are seen aggregated on the outer surface of the nuclear membrane. In some instances intra-nuclear vacuoles have also been observed with neurosecretory colloids collected along their walls and occasionally within them (Fig. 1).

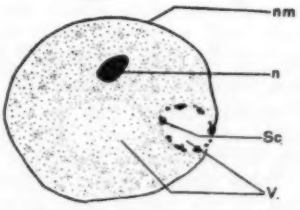

FIG. 1. Diagram showing the nucleus of a neurosecretory cell of the pre-optic region of the tadpole of *Rana hexadactyla*. *n*—nucleolus ; *nm*—nuclear membrane; *Sc*—secretory matter ; *V*—vacuoles.

The stainable intra-nuclear granules are not, however, confined to the larval neurosecretory cells. In adults also scattered granules of various dimensions are seen occasionally within the nuclei of the neurosecretory cells. But the bulk of the neurosecretory matter is found outside the nucleus, in the cytoplasm of the cells. These cells are bigger measuring about 14 μ to 25 μ in length with a nucleus of about 8·4 μ diameter and axons over 83 μ in length are of general occurrence.

Though the intra-nuclear production of neurosecretory matter has not been observed in Amphibians so far, it has been shown to be present in the pre-optic nucleus of cat fishes[4] and the eel[5] and in crustacean neurosecretory cells.[6] It is interesting to note that the occurrence of intra-nuclear neurosecretory matter is more marked in the tadpole stages than in the adults of *Rana hexadactyla*.

I wish to thank Dr. K. Bhaskaran Nair for facilities and guidance, and Dr. K. K. Nayar for constant help, encouragement and guidance.

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SOME OBSERVATIONS ON THE CYTOLOGY AND ANATOMY OF *HYPODEMATIUM CRENATUM* (FORSK.) KUHN.

GENUS *Hypodematium* Kunze is one of the little known genera of the Leptosporangiate Ferns. There is a variety of suggestions regarding its phyletic position. Ching[2] considers it a genus of Thelypteroid affinity. Copeland[3] places it near *Woodsia* as was originally suggested by Kunze, while Holttum[4] describes it under the sub-family Tectarioideæ of the family Dennstædtiaceæ.

Ching[1] lists three species of the genus, namely *H. crenatum* (Forsk.) Kuhn., *H. fordii* (Baker) Ching and *H. cystopteroides* Ching, the latter two species being known only from China. The type species *H. onustum* Kunze is regarded as a synonym of *H. crenatum* (Copeland[3]). *H. crenatum* has a wide range of distribution from Arabia to Southern Asia and Japan. In Himalayas it ranges from Garhwal to Bhotan (2,000-7,000'), Khasya (2,000-4,000'), South India and Western Ghats. At Mussoorie the species grows in abundance between Kempty Falls and Jamna Bridge as reported by Mehra.[5]

The present note aims to record the chromosome number of the species *H. crenatum* and chief points in its stelar anatomy. The basic chromosome number for the genus is not known so far.

The material was collected from Chakrata road on the way to Kempty Falls. Fertile leaflets were fixed in 1 : 3 acetic alcohol prior to squashing in aceto-carmine. Stelar anatomy was studied by extracting the stelar skeletons in their entirety.

The species grows on ledges and in crevices of huge cliffs of limestone along the roadside under highly xerophytic conditions. The rhizome is short, creeping and dorsiventral. The fronds are borne crowded together on the dorsal side. The insertions tend to form diagonal as well as longitudinal rows without any

regularity. A few buds may be present mostly laterally to the petioles but these remain dormant as long as the parent rhizome continues its growth. From the ventral side long, wiry adventitious roots are struck into the cracks. The rhizome as well as the basal portion of the stipe are densely clothed with golden brown, linear and lanceolate scales. The scales according to Ching[1] are naked and without any marginal projections but in our material occasional marginal peg-like projections or even sometimes long, multicellular filaments resembling somewhat those of *Tectaria* are noticeable. Stipe is inflated at the base and abruptly becomes slender above. Lamina 3-4 pinnate, deltoid, lowest pinnæ the largest, setose throughout with unicellular needle-like hairs. Sori are borne dorsally on the veins on the under-surface of the frond on prominent receptacles. Indusium is hairy throughout, reniform, usually asymmetrical, attached by a deep sinus.

At 'diakinesis' 41 bivalents are observed without doubt (Fig. 1). The meiosis is perfectly normal and 64 functional spores are formed. This chromosome number for the species indicates its possible affinity with genera like *Woodsia*, *Dryopteris* and *Ctenitis*, etc.

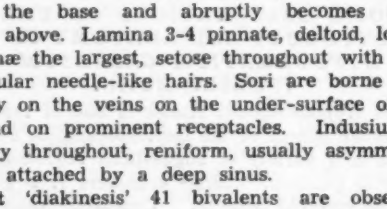

FIG. 1. $n = 41$, × 1,140.

The rhizome is dorsiventral and its ventral side is traversed by a single broad meristele (Fig. 2 A). This meristele remains undissected throughout its length because of the absence of the leaves on this side of the rhizome. The root traces are mostly given off from its central portion. Traces to the buds are associated with the margins of this meristele.

The dorsal stele presents a highly dissected picture because of the insertion of leaf traces (Fig. 2 B). There are two or three dorsal meristeles, the number being determined by the rows of leaves present (commonly three rows but at places only two). These dorsal meristeles are united with the ventral meristele through small vascular bridges at the regions of the initiation of the leaf gaps. No root traces are ever given off from the dorsal meristeles.

The leaf trace is binary (Fig. 2 B). The two vascular strands depart just at the point of the initiation of the gap or a little above from either side of the cauline meristeles enclosing the gap. These strands extend as such into the petiole but in the rachis they ultimately get united to form a single 'V'-shaped meristele.

A B

FIG. 2. A and B. Stelar skeleton from a portion of rhizome showing (A) ventral and (B) dorsal views. Diagrammatic, about double the natural size.

The trace to the pinna is extra-marginal, being the characteristic of many genera of Dryopteroid affinity.

The present study reveals that the genus is interesting because of its synthetic nature. The species has a combination of characters which are shared by a number of other genera like *Woodsia*, *Dryopteris*, *Tectaria*, *Thelypteris* considered both primitive and advanced which have been placed in separate subfamilies by some recent workers. Detailed discussion on the affinities of the genus will be presented later. We are thankful to Mr. B. Khanna for help with the drawings.

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OCCURRENCE OF MEGASPORES IN THE COAL FROM THE SOUTH REWA GONDWANA BASIN*

SAMPLES of coal for microscopic studies were collected by the author[1] in 1951 from a number of coalfields in Vindhya Pradesh. Preliminary findings from the first lot of coal samples included one-winged spores of *Endosporites* and *Florinites*, two-winged spores of the type *Pityosporites*, pieces of wood assignable to the genus *Mesembrioxylon* and coniferous cuticles.[2] The second lot of samples macerated with the usual Schultze solution yielded a few megaspores, besides a great number of spores, wood fragments and cuticles.

The presence of megaspores in the coal from the South Rewa Gondwana Basin is interesting as it affords evidence for the existence of Lycopodiaceous vegetation in the Palæozoic of India which is otherwise unknown. Except Raniganj and Jharia coals, other Lower Gondwana coals have shown a few megaspores. Record of megaspores from Indian coal is on the whole scanty. Fossil megaspores from India have been reported by Mehta,[3] Sitholey,[4] Sahni,[5] Trivedi[9] and Tripathi.[8] The present author[1] has also reported megaspores from coal from a thin seam exposed in Bandha Nala, south of Ujehni (24° 10′ : 82° 25′), Vindhya Pradesh. The number of megaspores released from the Ujehni sample is great. These are being arranged under different types and an attempt is being made to describe these and to discuss their affinities. Apart from these reported megaspores, the author has not come across any other published record of megaspores from India. Due to lack of sufficient data of plant constituents of coal from the different seams in Vindhya Pradesh, it is not yet possible to differentiate and correlate the coals and the coal-seams of the area. Further details of fossil flora of the area may no doubt help in solving this problem.

Regarding the samples from the first seam in Mine 2, Dhanpuri (Burhar), at 23° 11′ 15″ N : 81° 35′ 30″ E, it was found that all the megaspores are radially symmetrical with distinct proximal and distal sides. The proximal surface is marked by triradiate sutures which in some of the types extending upto the periphery. The distal side is generally smooth or variously ornamented. The proximal side is not so well ornamented as compared to the distal one. Most of the megaspores are well preserved and their ornamentation and the triradiate marks are very clear. Some of the megaspores are covered with finger-like appendages which are bifurcated into 2-4 branches at the apex. The megaspores vary greatly in size and some are relatively very large upto more than 2 mm. (This increase in size in some of the cases is certainly due to their flattening under high pressure.) Most of the megaspores range between 440 μ—1·5 mm.

The megaspore (Fig. 1) is somewhat roundish in shape and measures ca. 896·4 μ × 846·6 μ

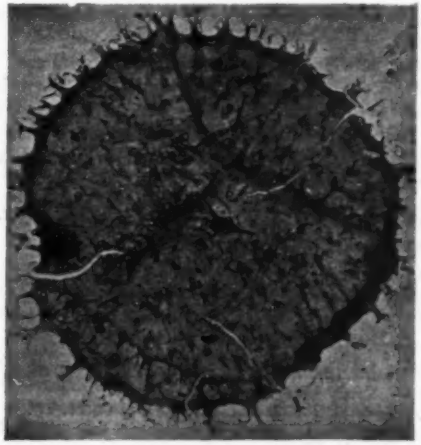

FIG. 1. Megaspore with triradiate mark and spiny surface, × 100.

in diameter. The triradiate mark is clear. The arms of trilete are almost extending to the margin. The surface of the megaspore is thickly studded with short and pointed spines mostly bifurcating into 2-4 branches near their ends and these branches are curling outwards on either side. Spines ca. 66·4 μ long and ca. 12·3 μ-16·6 μ broad near the base. The megaspore shows an affinity with the free-sporing lycopsids and may be placed in the genus *Triletes* Reinsch.

The other megaspore (Fig. 2) is roundish in shape with smooth and transparent exine. The surface is with many folds. Maximum diameter ca. 496 μ × 464·8 μ. Commissural ridges (triradiate mark) clear, one of the ridges just extending to the periphery and the other two ridges about 1/3 away from the periphery. From its size, shape and surface characters this megaspore can be placed in the genus *Selaginellites*.[4]

* The work has been carried out with the help of a research grant awarded by the Scientific Research Committee of the U.P. Government.

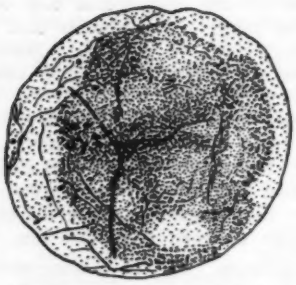

FIG. 2. Megaspore with transparent exine and smooth surface, × 90.

A detailed account will be published elsewhere.

The author expresses his indebtedness to Prof. K. R. Mehta for guidance and keen interest evinced in this work, to Dr. G. S. Puri for help and valuable suggestions and Dr. L. B. Singh for facilities and constant encouragement.

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THREE UNDESCRIBED SPECIES OF XANTHOMONAS

WHILE making a plant disease survey around Poona, the authors came across three bacterial diseases which on morphological and cultural studies proved to be undescribed species of Xanthomonas. A preliminary account of the symptomology, morphology and biochemical characters of the disease inciting organisms is presented here.

Xanthomonas spermacoces sp. nov. Srinivasan, Thirumalachar and Patel.—A bacterial disease inciting severe spotting on the leaves of *Spermacoce hispida*, Linn. (Rubiaceæ) was observed during August-September, 1955. The pathogen produces a few to several water-soaked, dark-black, circular, crust-like spots on the leaves. These spots sometimes coalesce and produce large, irregularly blotched areas. The organism is so far found to be restricted to *S. hispida* and since no bacterial disease has so far been reported on this host, the pathogen is assigned the status of a new species. The technical description of the pathogen is briefly as follows:

Short rods with rounded ends; single or in chains of two; measuring 1·2-2·0(1·6) × 0·5-0·9(0·7) μ; gram negative; capsulated; non-spore-forming; non-acid fast; motile by a polar flagellum; colonies on potato dextrose agar plates, circular with entire margins, glistening, butyrous, measuring 8-11 mm. in 8 days, Barium yellow (R); good, cloudy, yellow growth in nutrient broth; growth on potato cylinders copious; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia and hydrogen sulphide produced from peptone; nitrates not reduced; indol not produced; M.R. and V.P. tests negative. In a peptone-free medium, acid without gas from dextrose, sucrose, lactose and mannitol; alkali in raffinose and acetic acid; no growth in salicin. Loeffler's blood serum liquefied within 10 days; optimum temperature for growth 28-30° C.; aerobic; thermal death-point 51° C.

Pathogenic on leaves of *Spermacoce hispida*. Collected at Pimpri, near Poona.

Xanthomonas tribuli sp. nov. Srinivasan, Thirumalachar and Patel.—The disease appears as minute, water-soaked spots visible on the under-surface of the leaves of *Tribulus terrestris*, Linn. (Zygophyllaceæ), which with the advancement of the disease turn darker and appear adaxially as deep brownish-black and rounded areas. Under conditions of heavy infection, the spots coalesce and cause defoliation. Bacterial exudation is evident in the form of fine crusts on the upper surface of the leaves. Since no bacterial pathogen has so far been described on any member of Zygophyllaceæ, it is presented here as new to science with technical description as follows:

Slender rods with rounded ends; single or occasionally in chains of two; gram negative; capsulated; non-sporing; non-acid fast; motile by a polar flagellum; measuring 1·6-2·2(1·9) × 0·7-0·9(0·8) μ; colonies on potato dextrose agar plates, circular with entire margins, smooth, glistening, butyrous, measuring 7-8 mm. in 8 days, Pinard yellow (R); very heavy growth in nutrient broth with a thick pellicle; growth on potato cylinder copious and flowing;

gelatin liquefied; starch not hydrolysed; casein digested; milk peptonised; litmus reduced; ammonia from peptone but no hydrogen sulphide; indol not produced; nitrates not reduced to nitrites; M.R. and V.P. tests negative. In peptone-free medium, acid without gas from dextrose, maltose, lactose, sucrose and glucose; no growth in salicin and dulcitol; Loeffler's blood serum liquefied. Optimum temperature for growth 28° C.; aerobic; thermal death-point about 53° C.

Pathogenic on leaves of *Tribulus terrestris*. Collected at Pimpri, near Poona.

Xanthomonas blepharidis sp. nov. Srinivasan, Patel and Thirumalachar.—The disease symptoms on the leaves of *Blepharis molluginifolia*, Pers. (Acanthaceæ) are first visible as minute, circular, water-soaked, greenish to light brown spots on the lower surface, the corresponding areas on the upper surface appearing as minute, black dots. With the advancement of the symptoms, the spots enlarge in size, turning deep brown to dark black, and sometimes angular when coalescing. Bacterial exudate in the form of very fine scales is evident on the lower surface of the leaves. Since this is the first record on a member of Acanthaceæ, the pathogen is assigned a new name. Its technical description is as follows:

Short rods with rounded ends; single but rarely in chains of two; measuring 1·5-1·9(1·7) × 0·6-0.8 (0.7) μ; gram negative; non-spore-forming; non-acid fast; capsulated; motile by a polar flagellum; colonies on potato dextrose agar plates, circular with entire margins, butyrous, glistening, Barium yellow (R); good growth in nutrient broth; copious, yellowish growth on potato cylinders; gelatin liquefied; starch hydrolysed; casein digested; milk peptonised; litmus reduced. In peptone-free medium, acid without gas in dextrose, sucrose, lactose and mannitol; alkali in acetic acid; very poor growth in dulcitol and no growth in salicin; ammonia and hydrogen sulphide produced from peptone; indol not produced; nitrates not reduced; M.R. and V.P. tests negative; Loeffler's blood serum liquefied; optimum temperature for growth 27-30° C.; aerobic; thermal death-point about 52° C.

Pathogenic on leaves of *Blepharis molluginifolia*. Collected near Parvati Hills, Poona.

Fuller details will be published elsewhere.

Plant Path. Lab., Agric. College, Poona, *September* 4, 1956.

M. C. Srinivasan.
M. K. Patel.

CRYSTALLINE COMPONENTS OF CERTAIN INDIAN PINES

Samples of *P. longifolia* and *P. gerardiana* used in the present work were kindly supplied by the Chief Conservator of Forests, Himachal Pradesh, from North-West Himalayas; and *P. khasya* was collected by Prof. Seshadri from Khasi Hills. The method of extraction and fractionation was the same as has already been described by Mahesh and Seshadri.[1]

The heartwoods of *P. longifolia* and *P. gerardiana* have been subjected to chromatographic study by Linstedt and Misiorny,[2] who detected the presence of pinobanksin, pinocembrin and pinosylvin in *P. longifolia* and pinobanksin, pinostrobin, strobobanksin, pinosylvin pinosylvin monomethyl ether and dihydropinosylvin monomethl ether in *P. gerardiana*.

In the present study the heartwood of *P. longifolia* revealed the presence of pinobanksin (·02%), pinocembrin (·015%) and a stilbene derivative which was identified as pinosylvin monomethyl ether (·02%). From the heartwood of *P. gerardiana* could be isolated and characterised pinobanksin (·03%), pinostrobin (·005%), pinosylvin monomethyl ether (·05%) and 1-arabinose. The heartwood of *P. khasya* contained pinocembrin (0·12%), pinosylvin monomethyl ether (1·15%) and 1-arabinose.

The stilbene derivatives present in pines are responsible not only for the non-digestibility of pine heartwoods, but also for their high resistance to attack by wood destroying fungi.[3] These compounds were shown to inhibit the normal sulphite pulping by condensation with lignin[4] and were found to be very toxic to bacteria, fungi, insects, fish and mice. All the three pines studied here contain pinosylvin monomethyl ether and *P. khasya* having the largest percentage should be the most durable.

Our thanks are due to the Council of Scientific and Industrial Research for a research grant, and to Prof. T. R. Seshadri for his keen interest in this work.

Dept. of Chemistry, University of Delhi, Delhi-8 (India), *August* 28, 1956.

Y. K. Ahluwalia.
Ishwar Dass.
A. C. Mehta.

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NEUROSECRETORY PATHWAYS IN *CALOTES VERSICOLOR*

THE hypothalamo-neurohypophyseal tract as a pathway for the passage and discharge of the neurosecretory material produced in the hypothalamus, has been demonstrated in all major groups of vertebrates.[1–3] In certain reptiles the presence of another pathway leading from the cells of the paraventricular nucleus to the commissura pallii posterior and the paraphysis has been observed.[4,5] Yet a third route of exit for the neurosecretory material was described by Stutinsky in the eels.[6] This consisted of the axons of the cells of the preoptic nucleus discharging their contents into the cavity of the third ventricle. This pathway, according to Stutinsky, has not been observed in any other vertebrates.

Brains of garden lizards were fixed in Zenker-formol or Bouin's fluid, embedded in paraffin, sectioned at 6-7 micra thickness and stained by Gomori's chrome-hæmatoxylin phloxin method. Some sections cut at 15-25 micra thickness were stained by the urea-silver nitrate method as described by Ungewitter.[7]

The axons of the supraoptic and paraventricular nuclei stained deep blue by the chrome-hæmatoxylin method. Most of these axons passed down the infundibular stalk into the neurohypophysis where they ended in large masses of colloid in the matrix intervening between the ependymal layer and peripheral blood vessel zone. Some of the axons, however, ended in the distal half of the infundibular stalk where the intra-axonal granules coalesced and formed large masses of blue colloid (Fig. 1).

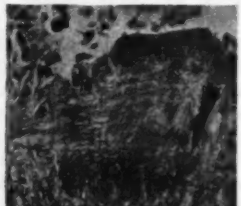

FIG. 1. Sagittal section of the infundibular stalk showing the fibres of the hypothalamo-hypophyseal tract and Gomori positive granules concentrating towards the peripheral blood vessels.

This material uniformly showed a very intimate relationship with the radicals of the portal blood vessels coming in from the anterior margin of the infundibular stalk.

The processes of the neurones of the paraventricular nucleus mainly coursed ventrally and laterally to join the fibres of the supraoptico-hypophyseal tract. However, the neurones belonging to the medial portion of the nucleus were seen to send in well-defined and thick processes towards the cavity of the third ventricle. These cells were scattered in the ependymal lining of the third ventricle, which in this situation consisted of stratified columnar and non-ciliated cells (Fig. 2). These fibres

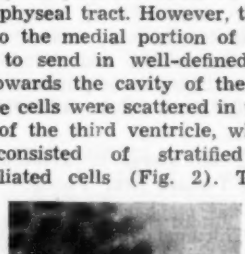

FIG. 2. Sagittal section of the hypothalamus showing a process of the paraventricular cell passing between the ependymal cells of the third ventricle. Towards the top right is the cavity of the third ventricle.

stained deep blue and often showed the typical beaded appearance exhibited by the axons of the neurosecretory cells. In certain other cases the processes stained less intensely, particularly at their terminal points, which gave the impression of their contents being discharged into the ventricular cavity (Fig. 3). The

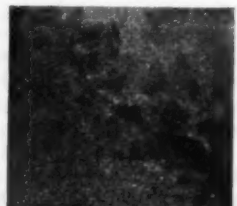

FIG. 3. Sagittal section of the hypothalamus showing a paraventricular cell lying in the ependymal lining. (The above sections were stained by Gomori's chrome-hæmatoxylin phloxin method. Photomicrographs, × 570.)

Gomori positive material has not been observed in the ventricular cavity itself.

In spite of very careful examination, no material resembling the neurosecretory colloid could be seen in the posterior pallial commissure or the paraphysis. Indeed, no Gomori positive cell or material was ever seen dorsal to the level of the sub-thalamus in any one of the specimens studied. This does not agree with the observations of Ananthanarayanan.[5]

Extra-cellular occurrence in the hypothalamus of relatively large globules of Gomori positive material was a very frequent observation. The significance of this is not known.

In *Calotes versicolor* therefore, the avenue for the discharge of the neurosecretory material consists of the hypothalamo-hypophyseal tract (shared with all the vertebrates studied so far) and possibly another exit (shared only with the eels as far as is known now) through the ventricle and the contained cerebro-spinal fluid.

I am greatly indebted to Professor V. Sitarama Rao for his valuable guidance in the investigations reported above.

Dept. of Anatomy, K. R. PANDALAI.
Andhra Medical College,
Visakhapatnam-1, *May* 17, 1956.

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OCCURRENCE OF HETEROSPORIUM DISEASE OF GARDEN NASTURTIUM IN INDIA

ON a trip to Mussoorie for the collection of mycological specimens during October 1955, a very severe leaf-spot disease of garden nasturtium (*Tropæolum majus* L.) caused by *Heterosporium tropæoli* Bond was observed in a few gardens. The disease is very conspicuous due to the blighted appearance of nasturtium flower beds. This disease has not hitherto been reported from India but has been recorded from U.S.A., Gautemala, Ceylon, New South Wales, and Tanganyka Territory. In California, where the crop is also grown commercially for seed production, the disease is reported to inflict heavy losses by reducing considerably the yield of nasturtium seed. It is a serious problem in garden plantings wherever the disease is found.

The fungus attacks the above-ground parts of the plant, such as tender stems, leaves and fruit. Leaf-spots appear first as tiny red flecks which enlarge and form round or irregular spots 0·5-2·0 cm. in diameter. Such spots are amphigenous, confluent and tan-coloured with a dark centre. Badly affected leaves become chlorotic and wither. The centre of the old spots dries up and sometimes cracks. Irregular discoloured areas are commonly seen on the infected fruit. The causal fungus has olive brown, septate mycelium which ramifies through the host tissues. Conidiophores grow out through stomata singly or in groups of two or three stalks on both the leaf-surfaces. They are olive brown, simple but sometimes branched, geniculate and are swollen at the tips. They are highly variable in size being 40-120 μ long and 7-10 μ broad. The conidia are olive brown with verrucose walls, cylindric, 1-3 septate with a broadened basal cell showing conspicuous scar, and constricted at the septa. They are borne successively singly at the new growing tips of the conidiophores and measure 28-45 μ.

In India this disease has been observed at Mussoorie which is situated at an altitude about 6,500 ft. Bond[1] observed this disease in Ceylon at 4,000-6,000 ft. elevation, which indicates that the disease is confined to cooler places. As the disease is reported to be seed-borne by Baker and Davies.[2] the possibility of its introduction into India through the infected seed, imported by some nursery men, cannot be ruled out.

Div. of Mycology and B. L. CHONA.
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REVIEWS

Peaceful Uses of Atomic Energy: Vol. 3: Power Reactors; Vol. 8: Production Technology of Materials Used for Nuclear Energy; Vol. 9: Reactor Technology and Chemical Processing. (Published by the Department of Public Information, United Nations, New York, U.S.A.) Available in India from: Orient Longmans Ltd., Calcutta, Madras and New Delhi. Price $ 10.00 each.

(i) *Volume 3* is a compilation of all important papers on power reactors submitted at the Geneva Conference on the Peaceful Uses of Atomic Energy held in 1955.

The first three papers deal with the economics of fuel cycles. Most of the discussions centre on the relative merits of thorium -U^{233} and plutonium -U^{238} fuel cycles. Of particular interest is the paper by Weinberg who gives a summary of different fuel cycles, the effects of fission product poisoning and the various reactor types. The discussions indicate fair prospects for the thermal U^{233}-thorium cycle with breeding gains of 10% to 15% or the fast Pu^{239}-U cycle where gains of as much as 50% may be obtained if the energy of neutrons is kept above ·1 Mev.

The second part is mainly devoted to the working of nuclear power plants. The atomic power station of U.S.S.R., using a water-moderated, water-cooled, 5% enriched uranium fuelled reactor is described in detail. The reactor has an overall power of 30 kw. and produces 5 kw. electrical energy. Experiments on boiling water power reactors conducted in the States using 90% enriched uranium are described in the next paper. This paper describes the various characteristics as well as the economics of such power plants.

The next section contains mainly papers on natural U-graphite reactors. The gas-cooled reactors that are now being built by U.K. and France as well as designs on water-cooled and sodium-cooled reactors are discussed. The advantages of boiling types of reactors especially for small economical plants have been brought out in a number of papers by U.S.S.R. and U.S.A. Though this type of reactors still offers a number of engineering difficulties, it is felt that these difficulties could be surmounted in the near future.

The last section contains descriptions of certain prototype reactors, like the pressurised water reactors and aqueous homogeneous reactors. There is also a review of power reactor experiments conducted at Los Alamos.

This is the first time that such a consolidated report on the engineering designs and difficulties of various types of power reactors has been published. The discussions of the papers included in the volume would be of great help since they contain information usually not found elsewhere. This collection of papers and discussions on power reactors would be of great help to both engineers and physicists in deigning future power reactors.

G. S. MANI.

(ii) *Volumes 8 and 9* under review constitute two of the three volumes devoted to the chemical aspects of the peaceful uses of atomic energy.

Volume 8 is divided into seven sections. Nearly a quarter of the volume is devoted to the treatment of uranium and thorium ores, and the contributions give a clear picture of the principles involved in the concentration of the ore as well as the recovery. These include both solvent extraction and ion exchange processes, metallurgical techniques that have come into prominence by their utilisation in this field on account of the need for extraction even from low grade ores. In this series, an interesting contribution by Marvin shows the possibility of physical benefaction as a commercial technique. The studies have also shown the limitations of the flotation method.

Seven papers in the next section give a clear picture of the production of metallic uranium and thorium. In the production of raw materials, several problems of analytical chemistry have arisen, and naturally a large number of contributions are devoted to this aspect. The variety of raw materials needed—as many as twenty different elements are involved—have necessitated a large amount of work on microtechniques, both physical and chemical, and all these find a place, with a clear indication of the limitations of each technique.

One of the important components in the utilisation of atomic energy is heavy water, and the papers presented cover the different methods

of large-scale preparation. These clearly show that from all angles, by far the best method is the one of deuterium exchange with steam. Another equally important material is graphite and we have a glimpse of the different aspects of production of the pure material from coke as well as petroleum coke. In the record of the session we have just an indication that suitably treated natural graphite can also find its use.

The study of atomic energy has brought into prominence two 'rare' metals, zirconium and beryllium. The discovery of hafnium was preceded by a study of zirconium minerals and the production of pure zirconium by the separation from hafnium has had special attention. The last two sections of the volume give a review of the relevant chemistry of zirconium and of beryllium.

Volume 9 deals with the various problems arising from technological studies of nuclear energy utilisation. Prominent among these is the disposal of waste, and this covers a good part of the volume. The discussions clearly show that the major controlling factor determining the extent of the use of atomic energy is the disposal of reactor and fuel processing waste. Other sections are devoted to metallurgy of reactor fuel elements, the system of intermetallic compounds met with, and problems in the handling of liquid metals that find extensive use for heat transfer in fuel systems. Several contributions bring out clearly the corrosion problem in the handling of molten liquid metals. As may be expected, nearly a third of the volume is devoted to the problem of processing fuel elements. The discussions bring out the picture that "the efficiency of any nuclear programme depends not only on efficiency of the nuclear reactor but in the efficiency of processes in all other stages of the fuel cycle". We find also the special features of reactors with liquid and fluidised fuels with an elegant homogeneous aqueous reactor.

The nature of the two volumes precludes an adequate analysis of all the valuable material presented though one cannot help the feeling that in considering the disposal of radioactive waste, the hazards are unduly toned down.

The volumes are well produced, comparatively free from typographical errors, and the price quite moderate. These volumes should find a place in the library of every institution of higher studies in chemistry.

S. V. ANANTAKRISHNAN.

Advances in Protein Chemistry, Vol. 10. Edited by M. L. Anson, K. Bailey and J. T. Edsall. (Academic Press, New York), 1956. Pp. viii + 425. Price $ 9.00.

Rapid strides have been made in recent years by scientists investigating different aspects of protein chemistry with the result that biochemists eagerly await the publication of the *Advances in Protein Chemistry* in order to get an authoritative account of the latest advances in this field of scientific endeavour. The volume under review, which is the tenth in the series, has six very good articles on various topics in protein chemistry. Thus, G. E. Perlmann, in discussing the nature of phosphorus linkages in phospho-proteins, has given experimental evidence for the existence of diester and pyrophosphate bonds in proteins. As in the case of the sulphur bridges, the phosphorus in proteins can either link different peptide chains or may serve to connect two sites of a single chain in a cyclic loop. C. E. Dalgliesh in his article on the metabolism of the aromatic amino-acids has dealt at length on those aspects of the metabolism of phenylalanine, tyrosine and tryptophane not concerned with the synthesis or breakdown of proteins or peptides. Thus, he has given in detail experimental evidence to show that glucose is the precursor of the aromatic ring and is converted to shikimic acid, a common precursor of the aromatic amino-acids. The various pathways by which tryptophane got metabolised in various organisms are also described in detail.

In the third article, J. Steinhardt and E. M. Zaiser have dealt with hydrogen-ion equilibria in native and denatured proteins. The acid-base dissociations of proteins is a subject of fundamental importance and hence this extensive review will prove very valuable. Fish proteins written by G. Hamoir of Belgium provides exhaustive data on proteins in a variety of fishes as also details of various enzymes which split these fish proteins. The next essay on the sea as a potential source of protein food is written by L. A. Walford and C. G. Wilber in a style quite different from those of the rest. In this survey, the authors have, however, brought in certain non-essential considerations, such as the following in p. 296.

"In India, fishermen are close to the bottom of the caste hierarchy. They are wretchedly poor, illiterate, conservative. Those among them who are ambitious try to elevate their status by finding more respected employment as cooks, water-carriers, porters, domestic

servants and so on." In the reviewer's opinion, human nature being what it is, fishermen are the same all the world over, and as in the United States, they do display a general tendency even in India to abandon fishing for 'more comfortable or better paying occupations'.

The last article on zinc and metallo-enzymes by B. L. Vallee is a very good exposition of the subject and deals extensively with zinc containing proteins and enzymes. The get-up of the book is good and only one misprint was detected in p. 239. On the whole, the subjects have been well chosen and presented and are bound to attract the attention of all interested in the chemistry of proteins. P. S. SARMA.

Terramycin (Oxytetracycline)—Antibiotics Monograph No. 6. By Merle M. Musselman with the collaboration of H. L. Davis and H. W. Mcfadden, Jr. (Editors: H. Welch and Felic Marti-Ibanez.) (Published by Medical Encyclopædia, Inc., New York, N.Y. Distributors outside U.S.A. Interscience Publishers, Inc.), 1956. Pp. 144. Price $4.00.

There is such a torrential flow of papers on antibiotics, that one anxious to have a thorough knowledge of the subject is finding it impossible even to cope up with it, let alone assimilate and digest the information. Even the specialist has progressively to cut down the aperture of his field of speciality to remain a specialist all. To those caught in this desperate situation, the *Antibiotics Monograph* edited by Welch and Marti-Ibanez come as a very welcome relief.

The attractive feature of these monographs is that the specialists have given a digest of the particular subject chosen in a very terse and business-like form in a volume which could be gone through in a few hours. The present monograph is one of six already appeared and to be followed by nine more. This monograph on one of the most useful of the antibiotics gives practically all the information about oxytetracycline—the history, physical and chemical properties, the antimicrobial activity, the pharmacology and the principles of therapy, the classical application, the resistance, and reaction to it. The coverage is very thorough, and the density of information very high. The reviewer heartily recommends this monograph to the laboratory research worker, the clinical investigator and above all to the practising physician as the most complete, accurate and practical publication on oxytetracycline. The value to the investigator is enhanced by the inclusion of 650 references covering 14 pages.

K. GANAPATHI.

Chromosome Botany. By C. D. Darlington. (George Allen & Unwin Ltd., London), 1956. Pp. xii + 186. Price 16 *sh.*

This book gives in compact form our present knowledge of chromosomes and the part they play in plant life and is written by one who has made considerable original contributions in this field.

Chapter 1 states what chromosomes are, how they divide and how they are liable to change by crossing over, by inversion, by interchange, by fragmentation or by multiplication (polyploidy). The presence of heterochromatin and the occurrence of B chromosomes are also discussed. In the next chapter the orthodox methods of systematic botany are criticised and a plea made for the use of chromosome studies in taxonomy. In an ideal species the individuals exchange genes freely, *i.e.*, there is cross-breeding, regular meiosis and unrestricted crossing over between homologous chromosomes. The change from cross-breeding to in-breeding may lead to the formation of pure lines or to the production of true-breeding inversion or ring-producing interchange hybrids. Such in-breeding systems have very limited possibilities of evolving further. When autopolyploidy develops in plants, they tend more and more to reproduce vegetatively. Vegetative propagation destroys gene exchange and brings evolution to an abrupt end. At the same time, however, free gene exchange has to be restricted if a new species is to arise within a group either by the geographic or genetic isolation of certain members from the parent group.

Chapter 3 discusses chromosome ecology and chromosome geography. Where within a species there are different races having a wide range in chromosome number, it is sometimes possible, as in *Erophila verna*, to show correlation between chromosome number and the kind of habitat. When polyploids are found within a species, they may occur at the colonising margin of the species, *e.g.*, *Biscutella lævigata*. In fact, such change in chromosome number appears to facilitate colonisation. The basic number of chromosomes within a genus sometimes appears to increase as the species move away from the earlier home of the genus, *e.g.*, in *Leucojum*. In groups where interchange rings appear, *e.g.*, in *Eu-Oenothera*, the ring plants being more recent have moved away from the earlier home of the group where the species are pair-forming.

Chapter 4 deals with the evolution of chromosomes and plant species. Various ways by which chromosomes are altered are discussed.

The importance of allopolyploidy in the production of new species with a different basic number is stressed. On account of the production of allopolyploid species from wide crosses, plant evolution is not merely divaricate in time: it is also reticulate. Chromosome numbers change less in long-lived plants than in short-lived plants, the stability of chromosome number being correlated with the length of the reproductive cycle. Thus in annual plants basic numbers are fixed only for a few thousand generations but in woody plants they are usually fixed for many million years. The polyploids, apomicts and the ring-forming heterozygotes are marked by signs of stereotyping which preclude adaptation and therefore preclude ultimate survival.

The last two chapters are of particular interest to plant breeders as they deal with the history and improvement of our cultivated and ornamental plants. Various methods of improvement open to the plant breeder are discussed.

The book is well illustrated with diagrams and maps. It will be very useful at the post-graduate level to students of cytology, taxonomy and plant breeding. R. P. PATIL.

Methods in Enzymology, Vol. II. Edited by S. P. Colowick and N. O. Kaplan. (Academic Press, Inc., Publishers, New York), 1955. Pp. xx + 987. Price $ 23.80.

The present volume is the second of a series of four volumes on "Methods in Enzymology". These volumes have been written with the object of making a comprehensive compilation of the methods used in the study of enzymes. The first volume was reviewed in a previous issue of *Current Science* (1956, **25**, p. 67). The present volume maintains the general level of excellence and will be greatly welcomed by all active laboratory workers in biochemistry and allied fields. Much stress has been placed on the methodology of enzymes, *viz.*, assay methods, purification and properties, etc., providing an exhaustive guide to investigators in the fields of intermediary metabolism, biochemical aspects of nutrition, mode of action of drugs, etc., to all of which enzymatic processes in cellular function firmly hold the key.

The volume is divided into five sections. The first section, rightly the largest on account of its obvious importance, deals with enzymes of protein metabolism. In the next section on enzymes of nucleic acid metabolism, a detailed enumeration and description of the various processes in this rapidly progressing branch of biochemistry has been made. In particular, the article on some of the recently developed methods for the study of *de novo* synthesis of purine nucleotides should prove useful to those interested in the study of purine biosynthesis. The other sections dealing with enzymes in phosphate metabolism, coenzyme and vitamin metabolism and respiratory processes likewise give a thorough and up-to-date account of the respective subjects and the progress made.

The publishers should be wholeheartedly congratulated for enlisting a large number of distinguished investigators, each a specialist in the particular subject of his contribution. An equally impressive job has been done by the editors and the advisory board in arranging the articles in such a well-integrated manner. The documentation of the chapters is done well both with regard to the recency and number of references. The volume is indeed a befitting dedication to the memory of the late Dr. James B. Sumner, the pioneer enzymologist.

K. V. GIRI.

Books Received

High Energy Nuclear Physics—Proceedings of the Sixth Annual Rochester Conference, April 3-7, 1956. Edited by J. Ballam, U. L. Fitch, T. Fulton, K. Huang, R. R. Rau and S. B. Treiman. (Interscience Publishers), Pp. 54. Price $ 3.75.

Annual Review of Biochemistry, Vol. 25. Edited by J. Murray Luck, Frank W. Allen, Gordon Mackinney. (Annual Reviews Inc., Palo Alto, California), 1956. Pp. vi + 794. Price $ 7.00.

High Polymers, Vol. XI. (Polyethylene). By R. A. V. Raff and J. B. Allison. (Interscience Publishers), 1956. Pp. xi + 551. Price $ 16.00.

Elementary Practical Geology. By E. de C. Clarke, R. T. Prider and C. Teichert. (University of Western Australia Press, Nedlands, W. Australia), 1956. Pp. v + 172. Price 27 *sh.* 6 *d.*

Elements of Geology for Western Australian Students. By E. de C. Clarke, R. T. Prider and C. Teichert. (University of Western Australia, Nedlands), 1956. Pp. xii + 300. Price $ 40.

Changes of State—A Mathematical Physical Assessment. By H. N. V. Temperley. (Cleaver-Hume Press, Ltd.), 1956. Pp. xi + 324. Price 50 *sh.*

Analysis of Bistable Multivibrator Operation—The Eccles-Jordan Flip-Flop Circuit. By P. A. Neeteson. (Philips Technical Library), India: M/s. Philips Electrical Co., India, Ltd., 7, Justice Chandra Madhab, Calcutta-20, 1956. Pp. 82. Price Rs. 8-12-0.

PROGRESS IN NUCLEAR ENERGY REACTORS*

THE Geneva Conference on Atomic Energy resulted in the release of such a vast amount of information, that many attempts have been made to present this information in a compact and easily accessible form. The 'Progress in Nuclear Energy' Series does this in eight volumes, and the present volume is the second of the series and deals with reactors.

The first five chapters of the volume deal with research reactors while the remaining six chapters deal with power and production reactors. The research reactors are dealt with on a territorial basis, each of the chapters describing the reactors in Canada, U.S., U.S.S.R., the European Continent (France, Norway and Sweden) and the U.K.

The research reactors recently built or under construction are mostly of three types. Firstly we have the enriched U-ordinary water heterogeneous reactors of the M.T.R. and swimming pool type. These reactors have generally a small volume and a high power and flux density and are very useful in that they provide not only high thermal fluxes but also high fast fluxes, which are essential for radiation damage studies. There is a detailed description in the book of the design and construction of the M.T.R. and of the determinations of its various characteristics, and briefer descriptions of other reactors.

The other popular type of reactor is the heterogeneous heavy water one using mostly natural and sometimes enriched U. The European and Canadian reactors are all of this type and there are detailed descriptions in the book of the NRX in Canada and of the Chatillon and Saclay piles and of the many reactor physics experiments made with these. These types of reactors give high thermal fluxes and having fairly large volumes, are able to provide extensive experimental facilities. They are also very useful for testing out fuel assemblies and lattice designs for power reactors.

The third type of research reactors described are the homogeneous reactors in the U.S. using enriched U and ordinary or heavy water. These have many advantages but seem unable to give high fluxes.

The second half of the book is devoted entirely to a consideration of existing and proposed power and production reactors. The production part is important inasmuch as it appears that nuclear power will not be competitive with power from other sources unless the production of plutonium or U_{233} is taken into account. The power reactors in any country ultimately will not consist of a single type but of several types integrated for optimum power and production.

Britain and Russia seem to be interested in developing as soon as possible a reactor which would be able to produce large quantities of electrical power on a commercial scale. It is interesting that they have both pitched upon the graphite-U type as the one which promised quickest immediate development. There is a detailed description in the book of the Calder Hall reactors which have now come into operation. There is no description however of the Downreay fast reactor, which is the other type the British have decided to develop and only a very brief account of the Russian power reactor.

The rest of the book is devoted to a description of the proposed types of power reactors in the United States. The differences between the types lie mainly in the different ways of extracting and utilising the heat produced in the reactor. In the P.W.R. which is described in great detail, the heat transfer is made with pressurised water which attains a high temperature in the reactor without boiling, while in the boiling water reactor, steam is generated in the reactor itself. The P.W.R. is also interesting in that it employs a type of reactor with highly enriched U seeds in natural U assembly. In homogeneous reactors, the whole solution or slurry is circulated. There is a detailed description of the sodium-cooled graphite reactor. There is a discussion of fast reactors without a description of any actual reactor. The possibility of fast power reactors depends largely on high heat transfer performance which is just possible with liquid sodium coolant.

There is a very useful catalogue at the end of all reactors existing, dismantled, building or proposed. There is an interesting foreword by Sir Christopher Hinton.

S. B. D. IYENGAR.

* Edited by R. A. Charpie, D. J. Littler, D. J. Hughes, and M. Trocheris. (Pergoman Press, New York), 1956. Pp. x + 492. Price 100 *sh.*

SCIENCE NOTES AND NEWS

Alternaria zinnae Pape. in India

Zinnia elegans, a common ornamental plant in Delhi gardens, has been found to be badly damaged by fungus which has been identified as *Alternaria zinnæ* Pape. Messrs. B. L. Chona and J. N. Kapoor, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, report this for the first time from Northern India.

Utilisation of Plutonium

In a recent speech, Willard F. Libby, Commissioner, Atomic Energy Commission, U.S.A., urged chemists to learn a way of adapting the plutonium in atomic weapons for peaceful power uses. He challenged scientists to discover a way to "burn up" plutonium for fuel, should the day come when the weapons stockpile is considered large enough.

The fact that plutonium is highly dangerous has so far hindered its use in power development. Plutonium, like radiostrontium, emits alpha rays and accumulates in human bone. The need for increased safety precautions has so far made plutonium less attractive to experiment with than enriched uranium-235, the current source of power fuel.

Aluminium with the Hardness of Steel

A new method of electrolysis, known as hard or deep anode treatment, has been elaborated by Professor N. D. Tomashev and M. N. Tyukina, at the Institute of Physical Chemistry of the USSR Academy of Sciences, which makes it possible to obtain an oxide layer of extreme hardness, firmly bound with the basic metal, on the surface of aluminium and its alloys. The thickness of this layer may be 100-150 microns and more, this being several times the thickness obtained by previous methods. The thick anode film obtained by this method considerably increases the resistance of aluminium alloys to wear and friction. Furthermore, it lends the surface heat-resistance and electric insulating properties, capable of standing a tension of 2,000 volts.

Rocket Flight Around the Moon

Professor Chebotarev, of the Institute of Theoretical Astronomy of the USSR Academy of Sciences, has established the theoretical possibility of sending up a rocket for a flight around the moon and the return to earth, carrying a smaller amount of fuel than has hitherto been considered necessary. Professor Chebotarev's calculations have shown that the rocket only needs fuel during the first period of its flight, after which it will continue to move under the influence of the gravity of the moon, sun and earth.

According to these computations, the rocket will travel a maximum distance of 400,000 km. from the earth. The distance between the earth and the moon is 384,000 km. The velocity of the rocket will drop from 11 km. per second at the start to nought as it approaches the moon. Thanks to this, the rocket will fly round the moon, thus making it possible to observe that planet from the side not visible from the earth. The entire flight will take 10 days and nights.

Genetics Congress Resolution on Radiation Hazards

At the final session of the International Congress of Human Genetics which met recently in Copenhagen, Denmark, Herman J. Muller, of the University of Indiana, proposed the following resolution on radiation danger. It was passed unanimously by the approximately 400 participants.

"The damage produced by radiation on the hereditary material (of man) is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted.

"It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view of safeguarding the well-being of future generations."

Scientific Aid to Fishing

The latest addition to the fisherman's scientific armoury, the Kelvin Hughes Fisherman's Asdic, will be on the world's markets about the middle of next year. It is a new application of the technique of transmitting acoustic pulses which rebound from solid bodies and are recorded back in the boat. An expert operator can interpret from the blips and smudges not only that he is passing over a shoal, but

how many fathoms down it is, and even what type of fish.

With the Asdic, used in conjunction with new types of vertical echo sounders introduced simultaneously by the same firm, the chance of a slip between tin and blip appears to be materially reduced; for the Asdic transmits horizontal pulses which will reveal the positions of shoals anywhere round the boat up to 2,000 yards range.

Physics and Chemistry of Solids

The publication of an international research journal with the above title has been announced recently. The Journal will publish both theoretical and experimental papers dealing with original research in all aspects of the physical and chemical properties of solids and condensed systems. The principal fields of interest, however, will centre on (1) the electronic structure of solids and those physical and chemical properties which derive more or less directly from electronic structure, and (2) the fundamental statistical mechanics of condensed systems. Preference will be given to those contributions having the widest significance for the understanding of solid state properties in general, and emphasis will thus be on topics with some theoretical implications. The aim of the Journal is to bring together into a common forum the best contributions on the physics and chemistry of the solid state from all over the world. As in the case of *ACTA METALLURGICA*, it is a part of the purpose of the Journal to encourage greater interchange of ideas between physicists and chemists interested in solids. Other particulars can be had from the Editor-in-Chief, Professor Harvey Brooks, 224, Nyman Laboratory, Harvard University, Cambridge 38, Massachusetts, U.S.A.

Institution of Telecommunication Engineers, India

The first Technical Convention of the Institution of Telecommunication Engineers, India, will be held on December 30, 1956, at the National Institute of Sciences Hall in New Delhi.

The Convention will be preceded by the Annual General Meeting of the Institution on December 29, when Brig. Iyappa, the present President, will hand over charge of his office to the President-Elect, Prof. K. Sreenivasan, Head of the Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore.

At the Technical Convention, a number of papers on various aspects of telecommunication are expected to be presented. Those participating actively in the Convention include the National Physical Laboratory, Indian Institute of Science, Government Communication agencies such as All-India Radio, Posts and Telegraphs, State Industrial enterprises like Bharat Electronics and various Universities and colleges. The Convention, which is expected to be an annual feature, will provide for the first time in the country, a forum for all those working in the field of telecommunications to present papers and exchange information on topics of mutual interest.

Royal Institute of Chemistry, North India Section

At the Annual General Meeting of the North India Section of the Royal Institute of Chemistry held recently, the following Office-bearers were elected for the year 1956-57. *President*: Dr. B. Viswanath; *Hony. Secretary and Treasurer*: Dr. G. S. Saharia; *Auditor*: Mr. B. N. Sastri.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Chemistry to Shri D. Subrahmanyam for his thesis entitled "Some Studies in Cerate Oxidimetry".

The Gujarat University has awarded the Ph.D. Degree in Physics to Shri Shah Govindlal Zaverbhai for his thesis entitled "Nuclear Scattering of High Energy Nucleons".

The Madras University has awarded the Ph.D. Degree in Physics to Shri P. M. Mathews for his thesis entitled "On the Application of Some Recent Methods in Stochastic Theory to Physical Problems".

The Utkal University has awarded the Ph.D. Degree in Chemistry to Shri Hrushi Kesh Pujari for his thesis entitled "Preparation and Useful Applications of Some Thiazolidone Derivatives".

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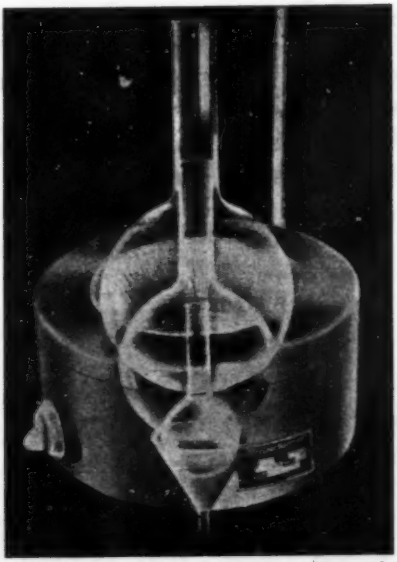

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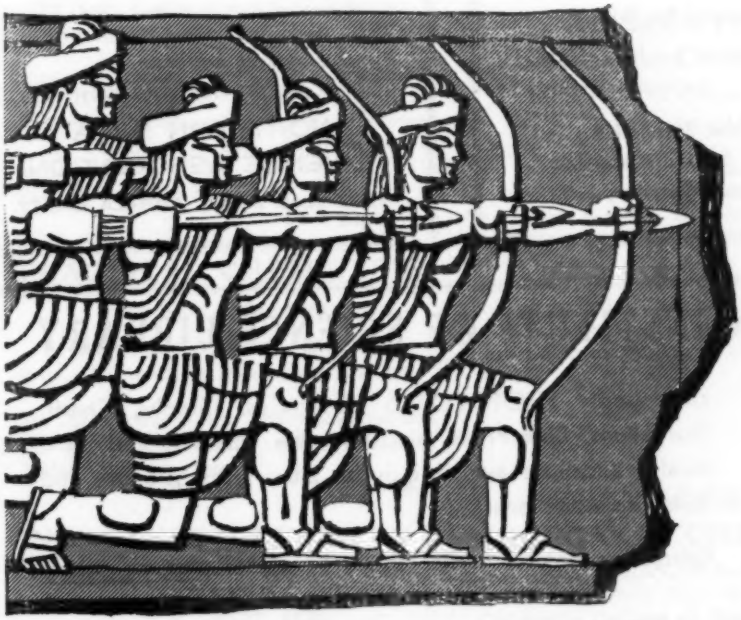

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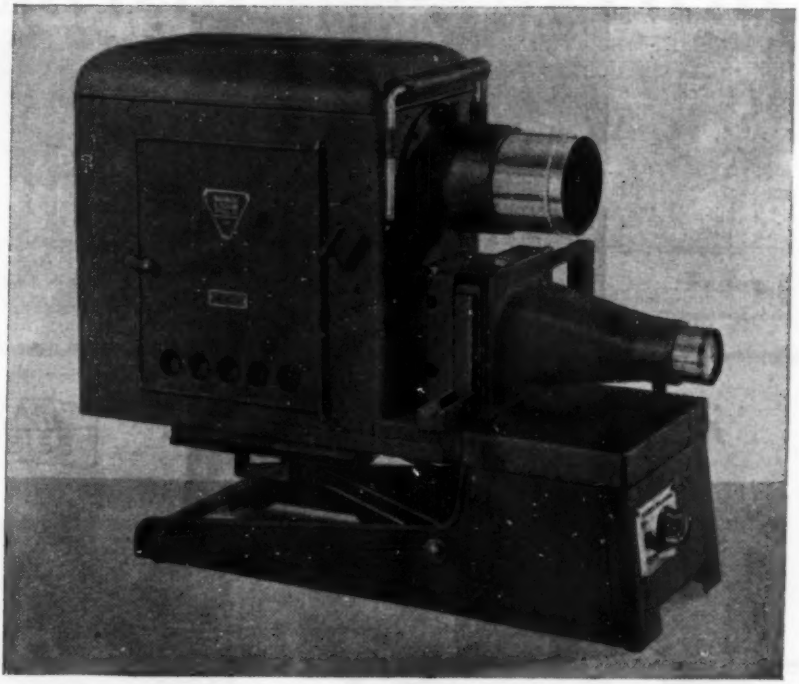

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